Index Issue

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Introduction

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The Preliminary Edition of the *NASA Thesaurus* (December 1967) (NASA SP-7030) is being used as the authority for the indexing vocabulary that appears in the subject index to this issue. The terminology has been modified from the *Guide to the Subject Indexes for STAR* (NASA SP-7016), the authority used for the vocabulary to indexes published prior to 1968. The *NASA Thesaurus* should be consulted for a total picture of the current indexing vocabulary including associated cross reference structure. Only the subject terms that have been selected to describe the documents abstracted in this issue appear in the subject index. Copies of the *NASA Thesaurus* may be obtained from the Clearinghouse for Federal Scientific and Technical Information or the U. S. Government Printing Office at a price of $8.50 for the three-volume set.

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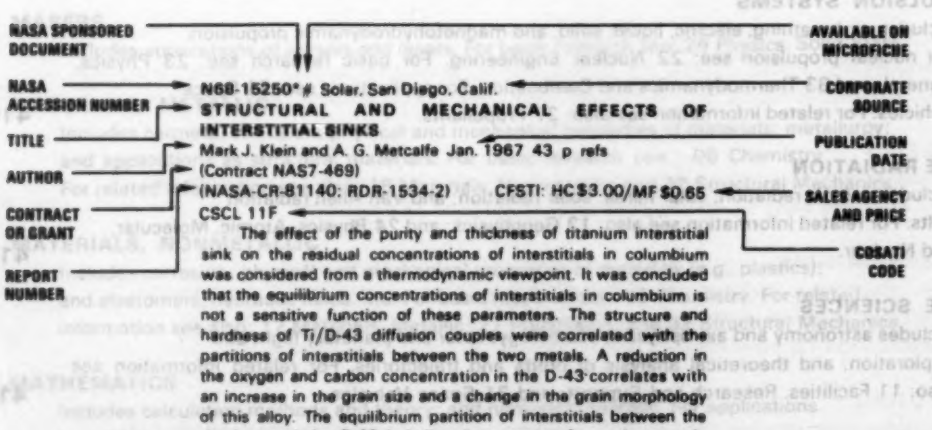
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N68-15250* # Solar, San Diego, Calif.
STRUCTURAL AND MECHANICAL EFFECTS OF INTERSTITIAL SINKS
Mark J. Klein and A. G. Metcalfe Jan. 1967 43 p refs
(Contract NAS7-469)
(NASA-CR-81140; RDR-1534-2) CFSTI: HC $3.00/MF $0.65
CSCL 11F
The effect of the purity and thickness of titanium interstitial sink on the residual concentrations of interstitials in columbium was considered from a thermodynamic viewpoint. It was concluded that the equilibrium concentrations of interstitials in columbium is not a sensitive function of these parameters. The structure and hardness of Ti/D-43 diffusion couples were correlated with the partitions of interstitials between the two metals. A reduction in the oxygen and carbon concentration in the D-43 correlates with an increase in the grain size and a change in the grain morphology of this alloy. The equilibrium partition of interstitials between the titanium and the D-43 is believed to account for an increase in the hardness of the titanium, but this partition does not seem to affect the hardness of the D-43. Author

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01 AERODYNAMICS

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N68-11911 France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.

BOUNDARY-LAYER EFFECT ON FLAT PANEL FLUTTER AT LOW SUPERSONIC SPEED [INFLUENCE DE LA COUCHE LIMITE SUR LE FLOTTEMENT D'UN PANNEAU PLAN EN SUPERSONIQUE FAIBLE]

Rolland Dat 1967 39 p refs In FRENCH; ENGLISH summary Presented at the 25th AGARD Conf., Ottawa, 24–29 Sep. 1967 (ONERA-TN-116(1967)) CFSTI: $3.00

The discrepancy between theoretical and experimental results was due to a boundary-layer effect, and we have found that the results of our calculations could be greatly improved if the real parts of the generalized aerodynamic forces were replaced by the experimental stationary values. In these conditions, the study of the boundary-layer could be momentarily limited to the stationary flow problem. A simplified theory based on a model proposed by Y. C. Young was developed. It leads to a mathematical model easy to use and constituting a considerable improvement in the evaluation of the pressure values on the panel in two- or three-dimensional flow in presence of a relatively important boundary-layer. This model includes two coefficients whose values are given by stationary flow testing. Author

N68-11936*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

BALLISTIC-RANGE TESTS OF A DRAG-RING CONFIGURATION AT MACH NUMBERS AROUND 2

Charles E. De Rose Washington Dec. 1967 23 p ref (NASA-TN-D-4291) CFSTI: HC$3.00/MF$0.65 CSCL 01A

Free-flight measurements of an unusual configuration proposed as a Mars atmospheric probe were made in the Ames Pressurized Ballistic Range. The configuration consisted of a cone-cylinder centerbody supported within a large conical-sector flare (called a drag ring) with a wide gap between the two components. Tests were made in air at a nominal Mach number of 2 and a Reynolds number, based on the drag-ring diameter of 50,000. All experimental data are compared with values obtained at a Mach number of 20 and with Newtonian theory to check the effect of a large change in flight velocity. A limited investigation was undertaken in the Pressurized Ballistic Range at Ames Research Center to study the drag, lift, and static and dynamic stability of this shape in air at a Mach number of approximately 2, and to photograph the flow around the free-flying model. The results of this investigation are reported here. Author

N68-11958*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EXPERIMENTAL PRESSURE DISTRIBUTIONS AND AERODYNAMIC CHARACTERISTICS OF A LOW-FINENESS-RATIO CYLINDER AT A MACH NUMBER OF 10.5 AND ANGLES OF ATTACK FROM 0° TO 90°

Thomas A. Blackstock and Philip E. Everhart Washington Dec. 1967 29 p refs (NASA-TM-X-1487) CFSTI: HC$3.00/MF$0.65 CSCL 01A

An investigation was made in the continuous-flow hypersonic tunnel to measure the surface pressures and the force and moment characteristics of a fuel capsule designed for use on the Nimbus B weather satellite. The capsule, a fineness-ratio-2 cylinder with a recessed face, was tested at angles of attack from 0° to 90° at a Reynolds number of 0.8×10^6 based on free-stream conditions and cylinder length. At angles of attack from 37° to 90°, forces and moments were also measured on a corresponding cylinder with a flat face. Pressures on the recessed face reached a maximum at angles of attack from 40° to 50°. Significant end effects on the pressure were concentrated within 1/2 diameter of the end of the cylinder. Analysis of the results indicated that normal force can be predicted within 15 percent by modified Newtonian theory. Agreement between experiment and theory for axial force was good near angles of attack of 0° and 90°, but the calculated results were generally somewhat low at other attitudes. The high pressure induced by the lip of the recess also produced a moderate increase in axial force, but had little effect on normal force. The recessed face greatly affected the pitching moment where large increases over the values for the flat-faced cylinder were noted. Author

N68-11974* Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.

STUDY OF STATISTICAL CHARACTERISTICS OF UNSTEADY PRESSURE Final Report, Aug. 30, 1966–Sep. 30, 1967

J. E. Pope and G. O. Dennis Nov. 1967 121 p refs (Contract NAS8-11410) (NASA-CR-91045; LMSC/HREC-A784519; HREC-1410-3) CSCL 01A

A digital program was developed to reduce and analyze data taken in wind tunnel tests of the Saturn-class vehicle models. The program was designed for the statistical characterization of the test data. A discussion of the mathematical and statistical

techniques used in the program is presented, as well as a discussion of the accuracy of some of the statistical quantities being computed. A user's guide for the computer program is included. Results of an analysis of certain Series IV Saturn V wind tunnel test data are presented to illustrate the various options that are available in the program. Author

N68-12010# ARO, Inc., Arnold Air Force Station, Tenn.
FREE-FLIGHT RANGE MEASUREMENTS OF SPHERE DRAG AT LOW REYNOLDS NUMBERS AND LOW MACH NUMBERS Final Report, 28 Jan.–8 Aug. 1967
W. R. Lawrence Arnold Eng. Develop. Center Nov. 1967 19 p
(Contract AF 40(600)-1200)
(AEDC-TR-67-218; AD-660545)

The drag coefficients of spheres were obtained from free-flight range tests of metal spheres at Reynolds numbers from 185 to 11,600 and at Mach numbers from 0.17 to 0.99. An analysis of the data indicates that the total errors in the measured drag coefficients are within +2 or -2 percent. Author (TAB)

N68-12039 Vereinigte Flugtechnische Werke G.m.b.H., Munich (West Germany).
UNSTEADY AIR FORCES ON COPLANAR LIFTING SURFACES IN SUBSONIC FLOW [INSTATIONAERE LUFTKRAEFTE AN KOPLANAREN TRAGFLAECHEN IN UNTERSCHALLSTROEMUNG]
B. Laschka and H. Schmid [1967] 25 p refs In GERMAN; ENGISH summary Presented at WGLR/DGRR Ann. Meeting, Karlsruhe, West Germany, Oct. 1967
(Rept.-28) CFSTI: $3.00

This report deals with the interference of three-dimensional unsteady air forces on two or more coplanar lifting surfaces, as represented by a wing-elevator combination in subsonic flow. A method for the calculation of the upwash field induced by oscillating wings and of the resulting pressure distributions on these wings is presented. The results show—especially for the aft surface—that the interference effects should by no means be considered as negligible. In contrast, the air forces induced by interference may reach the order of magnitude of those experienced on the isolated wing only. Author

N68-12120 Aeronautical Research Council (Gt. Brit).
WIND-TUNNEL TESTS ON A RECTANGULAR, TWIN-DUCT, VARIABLE-GEOMETRY AIR INTAKE AT SUPERSONIC SPEEDS
M. D. Dobson 1967 142 p refs Supersedes RAE-TR-66141
(ARC-CP-944) CFSTI: $3.00

Tests have been made in the 3 ft×3 ft supersonic wind tunnel on a rectangular twin duct air intake, which has variable geometry, over the Mach number range 1.7 to 2.2. The design Mach number of the intake was 2.12 and tests included an investigation of the effects of the variable geometry, throat bleed flow, transition fixing, splitter design, and afterspill for conditions of equal and unequal throttling of the ducts. Pressure recovery, duct mass flow, and bleed mass flow were measured and amplitude and frequency of pressure fluctuations were recorded. Maximum mean pressure recoveries recorded were generally up to 2-1/2% below the theoretical shock recovery. Recovery increases with the introduction of throat bleed and is dependent to some extent on transition of the boundary layer, bleed slot position and splitter design. At reduced duct mass flows both pressure recovery and distribution may be restored to "full flow" levels by careful use of afterspill. Unequal throttling produces interference effects on the "unthrottled" duct by the "throttled" duct. These effects may be eliminated by the use of afterspill in the "throttled" duct. Author

N68-12144 Southampton Univ. (England). Dept. of Aeronautics and Astronautics.
THE THEORETICAL DETERMINATION OF STABILITY DERIVATIVES OF BODIES OF REVOLUTION IN HYPERSONIC FLOWS, INCLUDING THICKNESS EFFECTS
C. J. Scott (M.S. Thesis) Apr. 1967 117 p refs
CFSTI: $3.00

After a summary of the theoretical methods of analysis available for the prediction of both steady and unsteady aerodynamic forces on pointed bodies at hypersonic speeds, Newtonian impact theory and shock-expansion theory are discussed in detail. The application of the latter to unsteady flows is examined critically, and a somewhat-empirical hybrid of the steady and 'unsteady' shock-expansion theories is formulated for the specific purpose of determining the quasi-static (frequency-independent) stability derivatives of a body of revolution which is not necessarily slender. Author

N68-12161# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
VORTEX WAKE ROLLUP AND VORTICITY CONCENTRATION BEHIND AN AIRFOIL
Thomas Arthur McMahon and Sheila Evans Widnall Jun. 1967 33 p refs
(Contract DA-31-124-ARO-D-471)
(ASRL-TR-143-1; AD-661070)

Some experimental evidence seems to confirm that the near wake problem is basically three-dimensional and should be reexamined as such. A concentration mechanism based on this three-dimensionality is proposed and found to predict a gradient of core circulation which is dimensionally correct and gives realistic answers when specific numerical cases are compared to published experiments. The correlation of experiment with theory involves a uniform translation of the theoretical points a specific distance upstream, implying that rotational fluid in the sheet requires a finite, uniform time to get to the core, no matter which downstream station is considered. A paradox in the role of viscosity in the concentrating mechanism is discussed. Author (TAB)

N68-12357 Aeronautical Research Council (Gt. Brit.)
DESIGN AND TEST OF A SERIES OF ANNULAR AEROFOILS
D. L. Ryall and I. F. Collins 1967 50 p refs Supersedes ARL(G)R6; ARC-27037
(ARC-R&M-3492; ARL(G)R6; ARC-27037) CFSTI: $3.00

The results of a series of wind tunnel tests involving velocity, surface pressure and force measurements on six annular aerofoils are presented together with details of the design procedure which was based on that given by Küchemann and Weber. It is shown that theoretical predictions agreed well with experimental results when the foils were in the design condition, i.e. uniform inflow at zero incidence. Pressure, lift and drag measurements were also made on the foils at incidence, and the results differed somewhat from predictions of lifting surface theory. Three foils were further tested with concentric centre-bodies and three others in an axisymmetric inflow; in both cases the theoretical predictions agreed well with experimental results. Author

N68-12393# Sandia Corp., Albuquerque, N. Mex.
DATA-REDUCTION TECHNIQUE FOR THE ANALYSIS OF NONLINEAR MOTION
James D. Iversen Jan. 1967 31 p refs
(Contract AT(29-1)-789)
(SC-RR-66-553)

A method is proposed for the determination of aerodynamic stability derivatives of flight vehicles from experimental free-flight or wind tunnel nonlinear motion data. Results of the method are compared with experimental data for one- and two-degree-of-freedom motion. Author (NSA)

N68-12409 Aeronautical Research Council (Gt. Brit.)
A THEORETICAL INVESTIGATION OF THE EFFECT OF ASPECT RATIO ON AXIAL FLOW COMPRESSOR PERFORMANCE
J. H. Horlock and G. J. Fahmi London HMSO 1967 32 p refs Supersedes ARC-28187
(ARC-CP-943; ARC-28187) CFSTI: $3.00

The performance of axial flow compressors is known to be affected by the choice of aspect ratio (the ratio of blade height to axial chord length). An analysis of the inviscid, incompressible flow in axial compressors of different aspect ratios is given in this paper. The main analysis is based on actuator disc theory, but a comparison is made between calculations based on this theory and the more recently developed streamline curvature analysis. This comparison shows close agreement between the calculations based on the two theories. Author

N68-12427 Aeronautical Research Council (Gt. Brit.)
AN EXPERIMENTAL INVESTIGATION OF THE INTERACTION BETWEEN A FORWARD-FACING STEP AND A LAMINAR BOUNDARY LAYER IN SUPERSONIC, LOW-DENSITY FLOW
E. W. E. Rogers, C. J. Berry, and B. M. Davis Jan. 1967 47 p refs Supersedes NPL-1139; ARC-26656
(ARC-R&M-3506; NPL-1139; ARC-26656) CFSTI: $3.00

Tests made near $M_0=2$ on flat plate and step combinations at stream static pressures between 30 and 70 microns show that pressure increases upstream of the step are dominated by parameters related to the model geometry; the static pressure and boundary layer thickness are unimportant. Thus the interaction is not of the free type. Some assessment is made of the separation position, the shape of the separation cavity and the pressure rise to separation. Author

N68-12428 Aeronautical Research Council (Gt. Brit.)
THE CALCULATION OF THE SPANWISE LOADING OF SWEPTBACK WINGS WITH FLAPS OR ALL-MOVING TIPS AT SUBSONIC SPEEDS
G. G. Brebner and D. A. Lemaire 1967 42 p refs Supersedes RAE-AERO-2553; ARC-18273
(ARC-R&M-3487; RAE-AERO-2553; ARC-18273) CFSTI: $3.00

The results of some electric tank tests on wings of 45 deg. sweepback with trailing edge flaps have been analysed to provide the basis for a method of calculating the spanwise loading. The analysis yielded information about the effect of sweep on the equivalent incidence of a section with flap, on the downwash factor and on the spanwise loading distribution with an incidence discontinuity. Interpolation formulae are developed to extend the results to wings of any sweep and flap span, and thus a complete calculation method is presented for the spanwise loading with this type of control. The calculation method is tentatively extended to a wing with all-moving tip control, and the results compared with those of Thomas and Mangler. There is a marked discrepancy between the two calculations. Further electric tank tests to fill this, and other gaps are suggested. Author

N68-12457 Aeronautical Research Council (Gt. Brit.)
LEAKAGE AND SECONDARY FLOWS IN COMPRESSOR CASCADES
B. Lakshminarayana and J. H. Horlock 1967 59 p refs Supersedes ARC-26821)
(ARC-R&M-3483; ARC-26821) CFSTI: $3.00

This paper describes the effects of leakage and secondary flows on lift, outlet angles, induced drag and loss coefficients in a rectilinear cascade of compressor blades in which spanwise gaps simulated the clearance spaces of an axial compressor. The resultant leakage flow was studied under three different conditions (i) with uniform inlet flow (ii) with non-uniform inlet flow near the gaps (iii) with severely non-uniform inlet flow and an end wall within the gaps. Author

N68-12480 Aeronautical Research Council (Gt. Brit.)
LOW-SPEED WIND-TUNNEL TESTS ON A 1/8th SCALE MODEL OF THE HANDLEY-PAGE HP.115
P. B. E. Engler and G. F. Moss 1967 34 p refs Supersedes RAE-TR-65180; ARC-27492
(ARC-R&M-3486; RAE-TR-65180; ARC-27492) CFSTI: $3.00

A series of tunnel tests was made on a slender wing design to provide a basis for the flight-tunnel comparison of data and to give general wind tunnel support for the flight research work on the aeroplane. The interim comparisons with flight which have been possible so far show good agreement as regards lift and lateral and directional stability, but significant differences in some control derivatives. Author

N68-12478 Aeronautical Research Council (Gt. Brit.)
ON THE DEVELOPMENT OF THE INCOMPRESSIBLE TURBULENT BOUNDARY LAYER
H. McDonald and J. A. P. Stoddart 1967 49 p refs Supersedes BAC-AE-225; ARC-27647
(ARC-R&M-3484, BAC-AE-225; ARC-27647)

An approximate method is outlined for predicting the behaviour of the incompressible, two-dimensional boundary layer under the influence of an arbitrary pressure distribution. The method is based on the moment of momentum integral equation and Coles' universal velocity profiles. A knowledge of the integral of the turbulent shear stress across the boundary layer is required and this is obtained from a correlation of experimental data. It is suggested that functions of the initial shear stress profile should be specified as starting conditions in a calculation in addition to the usual functions of the initial velocity profile. Empirical equations are found which enable the development of integral velocity and shear-stress profile functions to be calculated simultaneously. A comprehensive series of experimental comparisons are given, indicating a substantial measure of agreement between the predicted and the measured boundary-layer growth as long as the experimental flow remains reasonably two-dimensional. Author

N68-12492 Aeronautical Research Council (Gt. Brit.)
EXPERIMENTS WITH CONES IN LOW-DENSITY FLOWS AT MACH NUMBERS NEAR 2
E. W. E. Rogers, C. J. Berry, and B. M. Davis London HMSO 1967 43 p refs Supersedes NPL-AERO-1095; ARC-25713
(ARC-R&M-3505; NPL-AERO-1095; ARC-25713) CFSTI: $3.00

Surface-pressure measurements were made on two cones of 15 deg. and 30 deg. half angle at Reynolds numbers between 81 and 372. The viscous-induced pressure increments compare well with simple theoretical estimates. Some exploration was made of the flow behind one model and the effects of progressively larger truncations of both cone tips were investigated. Author

N68-12511*# Rice Univ., Houston, Tex. Dept. of Mechanical and Aerospace Engineering and Materials Science.
LIFT-TO-DRAG RATIOS OF LIFTING BODIES AT HYPERSONIC SPEEDS

Angelo Miele and Ho-yi Huang 1967 59 p refs
(Grant NGR-44-006-063)
(NASA-CR-66521; ARR-29) CFSTI: HC $3.00/MF $0.65 CSCL 01A

An investigation of the lift-to-drag ratio attainable by a slender, homothetic body flying at hypersonic speeds is presented under the assumptions that the pressure distribution is modified Newtonian and the surface-averaged skin-friction coefficient is constant. It is shown that a value of the thickness ratio exists such that the lift-to-drag ratio is a maximum; this particular value is such that the friction drag is one-third of the total drag. The subsequent optimization of the longitudinal contour is reduced to the extremization of the product of the powers of three integrals related to the lift, the pressure drag, and the skin-friction drag. In this connection, it is proved that a conical solution is the best. Concerning the transversal contour, a systematic analysis of the effect of the main geometric parameters of a cross section on the lift-to-drag ratio is presented. For a given elongation ratio, the following conclusions are derived: (a) the triangle is aerodynamically superior to the semiellipse and the rectangle, whether flat-top or flat-bottom; (b) the flat-bottom triangle is aerodynamically superior to the flat-top triangle; and (c) the diamond shape is better than the triangle, whether flat-top or flat-bottom. Author

N68-12514 Aeronautical Research Council (Gt. Brit.)
THE PRESSURE-DRAG DUE TO BLUNT LEADING EDGES ON TWO-DIMENSIONAL AEROFOILS, AT TRANSONIC AND LOW-SUPERSONIC SPEEDS
W. J. Graham 1967 34 p refs Supersedes NPL-AERO-1151; ARC-26955
(ARC-R&M-3465; NPL-AERO-1151; ARC-26955) CFSTI: $3.00

Pressure drags, obtained from measured pressure distributions in the transonic and low-supersonic speed range, are compared for sharp and blunt leading-edged two-dimensional aerofoils. For the special blunt shapes considered here, the high pressures in the stagnation-point region are offset by low pressures generated further round on the leading edge and on the basic aerofoil itself. The result is that the changes in pressure drag due to blunting are small and in some cases favorable. Author

N68-12536# Aerospace Corp., El Segundo, Calif. Aerodynamics and Propulsion Research Lab.
HYPERSONIC VISCOUS INTERACTION THEORY FOR SLENDER AXISYMMETRIC BODIES, 1 JANUARY–1 JULY 1967
H. Mirels and J. W. Ellinwood Sep. 1967 44 p refs
(Contract F04695-67-C-0158)
(TR-0158(3240-10)-1; SAMSO-TR-67-41; AD-660893)

Effects of viscous interaction are investigated for hypersonic flow over slender axisymmetric bodies. The entire range of interaction, from weak to strong, is considered for nose bluntness not greater than a 3/4 power law. Extensive numerical results are given for the self-similar flow over a 3/4 power law body. These results are correlated and used in a local similarity procedure for finding viscous interaction over arbitrary body shapes. Analytical expressions are derived for weak interaction on a cone and strong interaction on power law bodies. Following Deweys approach, the local similarity procedure is simplified to a series of algebraic equations. These are solved for flow of air over a cone. Numerical results are presented for cone surface pressure, shear, heat transfer, drag and displacement thickness in all interaction regimes. The drag is in good average agreement with available experimental cone drag data. The analytical development is a unified treatment of viscous interaction effects on two-dimensional as well as axisymmetric bodies. Numerical results for wedges are included. Author (TAB)

N68-12575# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROFILING THE SUPERSONIC SECTION OF AN AXISYMMETRIC MAXIMUM THRUST NOZZLE [O PROFILIROVANII SVERKHZVUKOVOY CHASTI OSESIMMETRICHNOGO SOPLA NAIBOL'SHEY TYAGI]
A. A. Sergiyenko and I. D. Sandomirskaya 28 Apr. 1967 30 p refs Transl. into ENGLISH from Moscow Univ. Vychislitelnyi Tsentr. Sb. Rabot (USSR), no. 4, 1965 p 77–102
(FTD-HT-66-801; AD-660728)

The problem of the optimum shaping of the supersonic portion of the nozzle is studied within the framework of the variational approach. Such degenerated variation problems are solved by means of the coupled variations at the different ends of the extremum curve which allow the positioning of the extremum curve through two assigned points. The basic relationships and the mathematical formulation of the problem are followed by a study of the extremum equation solution. The condition of transversality of the contour with fixed coordinate points, the presentation of the computational methods, a brief analysis of accuracy, and the presentation of the tabulated results. These show that the solution of the degenerated problem coincides with the solution obtained by means of the classical variational calculus of nondegenerate problems. TAB

N68-12616 Aeronautical Research Council (Gt. Brit.)
A PRELIMINARY EXPERIMENTAL INVESTIGATION OF SHOCK-WAVE DEVELOPMENT ON AEROFOILS
T. H. Moulden, I. J. Cox, and V. A. Stringfellow London HMSO 1967 22 p refs Supersedes NPL-AERO-NOTE-1042; ARC-27668
(ARC-CP-984; NPL-Aero-Note-1042; ARC-27668) CFSTI: $3.00

The transition process from a pure subsonic type flow to a mixed flow with a steady terminating shock wave was investigated by means of simple experimental methods. Attention was restricted to the flow past a two-dimensional aerofoil for Mach numbers at, and just above, the critical. The experiment demonstrates the way in which upstream-travelling disturbances slow down and ultimately coalesce at some point in the adverse pressure gradient. The velocity component of these disturbances along the chord line was measured for a range of free-stream Mach number. Author

N68-12621*# Kansas Univ., Lawrence.
ON THE TWO-DIMENSIONAL ATMOSPHERIC TURBULENCE RESPONSE OF AN AIRPLANE
David T. Sawdy (Ph.D. Thesis) [1966] 152 p refs
Grant NGR-17-004-012)
(NASA-CR-91116) CFSTI: HC $3.00/MF $0.65 CSCL 01A

A mathematical description of atmospheric turbulence is included, along with the requirements for airplane response calculations. The input–output relation and the two-dimensional gust analysis are formulated. Trend study response calculations include a description of the mathematical model, the aerodynamic representations of the generalized forces, spanwise variation effect of the vertical gust velocity on the longitudinal response of an airplane, and truncation error data. A multidimensional homogeneous and isotropic turbulent fluid flow description deals with the energy equation for isotropic flow, development of multidimensional spectra, and the Von Karman and Dryden representations. The trend study mathematical model description covers equations of motion, generalized forces, frequency response functions, response spectra, statistical parameters, parameter data, and truncation error data. M.W.R.

N68-12656# Sandia Corp., Albuquerque, N. Mex.
THE ANGULAR MOTION OF A ROCKET-PROPELLED VEHICLE IN FREE FLIGHT

George W. Stone Aug. 1966 32 p refs
(SC-RR-66-42)

The linearized aeroballistic equations of motion are developed for a vehicle with time-variant mass and moments of inertia arising from a thrusting rocket motor. An implicit exact solution is developed for a nonrolling body, and an approximate solution is determined for a rolling body. The approximate solution is compared with a 6-degree-of-freedom computer solution for a vehicle ascending through the atmosphere. Author

N68-12756 Aeronautical Research Council (Gt. Brit.).
WIND TUNNEL TESTS ON A NACELLE FITTED WITH TWO LIFTING FANS IN TANDEM
N. Gregory and Edna M. Love London HMSO 1967 35 p refs Supersedes NPL-AERO-1185; ARC-27688
(ARC-R&M-3494; NPL-AERO-1185; ARC-27688) CFSTI: $3.00

Lift, drag and pitching moment were measured up to a forward speed ratio of 0.55 with the fans installed with axes vertical and with 15 deg rearward tilt. Lift was adversely affected by interactions by mainstream and efflux. Yawmeter traverses revealed the effects of entry length and fan axis tilt upon the flow distribution, and also the influence of one fan upon the other. Author

N68-12792 Royal Aircraft Establishment, Farnborough (England).
CALCULATION OF THE ANGLES OF DOWNWASH OF FLOW BEHIND RECTANGULAR WINGS OF SMALL ASPECT RATIO AT SUBSONIC VELOCITIES ACCORDING TO NON-LINEAR THEORY [RASCHET UGLOV SKOSA POTOKA ZA PRYAMOUGOLNYMI KRYL'YAMI MALYKH UDLINENII PRI DOZVUKOVYKH SKOROSTYAKH PO NELINEINOI TEORII]
S. D. Ermolenko and M. T. Barinov Aug. 1967 16 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Aviats. Tekh. (Kazan), no. 3, 1966 p 3–10
(RAE-LIB-TRANS-1247) CFSTI: $3.00

Equations are presented for calculating the downwash behind rectangular wings of low aspect ratio in subsonic flow. The lifting effect of the wing is represented by a distribution of horseshoe vortices and the trailing vortices are not constrained to lie in the chordal plane of the wing. The method is restricted to the incidence range in which the flow remains attached to the wing, and the equations allow for compressibility effects below the critical Mach number by the Prandtl–Glauert transformation. The preferred method of calculating the appropriate distribution of horseshoe vortices and the direction of the trailing vortices is that of Ermolenko. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N68-11913# Palermo Univ. (Italy). Inst. of Transportation.
MARKET SURVEY FOR MEDIUM AND LONG RANGE AIR TRANSPORT [ESAME DEL MERCATO DEI TRASPORTI AEREI A MEDIO E LUNGO RAGGIO]
Vincenzo Correnti Sep. 1967 20 p refs In ITALIAN *Its* Pt. 1 of Rept. to the C.N.R. Working Group for Res. on Hypersonic Flight
CFSTI: HC $3.00/MF $0.65

The growth pattern of air traffic is discussed, and the factors affecting it are identified. These include the world political situation, economic and social trends, tariff levels, and the impact of new aircraft on travel. The question of who will prefer supersonic flight is considered. Market predictions are made in terms of the distribution between European and American industries, and production schedules are forecast. Transl. by T.Z.D.

N68-11917 Palermo Univ. (Italy). Inst. of Transportation.
PROJECTED OBJECTIVES AND CHARACTERISTICS OF THE FIRST GENERATION SUPERSONIC AIRPLANE [OBBEITTIVI DI PROGETTAZIONE E CARATTERISTICHE DEL VELIVOLO SUPERSONICO DELLA PRIMA GENERAZIONE]
Vincenzo Correnti Sep. 1967 46 p refs In ITALIAN *Its* Pt. 2 of Rept. to the C.N.R. Working Group for Res. on Hypersonic Flight
CFSTI: $3.00

The Anglo–French Concorde and the American Supersonic Transport design concepts are examined, and comparative data on the aerodynamic characteristics of each are presented. Emphasis is placed on the configurations, the obtainable velocities, maneuverability at lower speeds, the construction materials, the properties of the engines to be used, and the problems of installation. Operating costs, political factors, and the overall economic impact resulting from the introduction of such aircraft are also considered. Transl. by T.Z.D.

N68-11918 Palermo Univ. (Italy). Inst. of Transportation.
ON THE PRINCIPAL TECHNICAL AND ECONOMIC CHARACTERISTICS OF CIVIL AIRPLANES FOR HYPERSONIC TRANSPORT [SULLE PRINCIPALI CARATTERISTICHE TECHNICHE ED ECONOMICHE DEL VELIVOLO CIVILE DA TRASPORTO IPERSONICO]
Vincenzo Correnti Sep. 1967 53 p refs In ITALIAN *Its* Pt. 3 of Rept. to the C.N.R. Working Group for Res. on Hypersonic Flight
CFSTI: $3.00

The general problems pertaining to the development of hypersonic transports are assessed, and the feasibility of such aircraft is discussed. Attention is focused on aerodynamic considerations such as longitudinal and directional stability, structural materials, heat transfer, fuel selection, motor–aircraft assembly, propulsion, and attainable efficiencies. Configurations are depicted for Mach 6 to 8, Mach 8 to 10, and over Mach 10. Fuel consumption and its effects on operating costs are discussed, along with the overall commercial and economic impact to be expected from such aircraft. Transl. by T.Z.D.

N68-11982# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
PERFORMANCE AND STRESSES OBTAINED ON AN ISOLATED VTOL-TYPE PROPELLER OPERATING IN HOVERING, TRANSITIONAL, AND AXIAL FLIGHT Technical Report, Jun. 1965–Jan. 1967
Andrew R. Trenka Aug. 1967 97 p refs
(Contract DA-44-177-AMC-75(T))
(CAL-BB-1846-S-2; USAAVLABS-TR-67-37; AD-661087)

Experimental performance and blade stresses measured on a three-bladed VTOL-type propeller tested in free air are presented. The isolated propeller was tested over ranges of prop speed, forward velocity, blade angle setting, and thrust axis to free-stream angle. Correlation with a theoretical method of predicting propeller performance and blade stresses was made. It was found that when the propeller was operating in a flight condition for which the theory was developed, correlation between theory and experiment was good. When the propeller was operating in a flight condition where very small positive or negative effective angles of attack were encountered, correlation between theory and experiment was poor. Author (TAB)

N68-12028# Vitro Labs., Silver Spring, Md.
A SURVEY OF METHODS FOR CONTROLLING THE ALTITUDE OF FREE BALLOONS WITH AIR BALLAST SYSTEMS
Allen R. Davidson, Jr., John P. Jackson, and Robert E. Bassett 29 Sep. 1967 108 p refs
(Contract F19628-67-C-0192)
(AFCRL-67-0372; TN-02057-02-1; SR-1; AD-661281)

The report reviews background literature describing various concepts for using air to ballast a balloon system. A variety of air ballast concepts have been documented, but few flight operations using these systems have been reported. Air ballast concepts were grouped into three categories and analytical expressions were developed to describe the design characteristics and performance of each type system. The dominant factor affecting altitude control of a balloon system is shown to be balloon gas superheat which varies with atmospheric conditions and different balloon fabrics. It is the conclusion of this report that air ballast systems are technically feasible, and that simple non-powered sealed gas container systems will compete favorably from an economic viewpoint with conventional balloon and ballast systems on long duration flights. Further development of air ballast systems for altitude control of balloons is recommended. Author (TAB)

N68-12176# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TRIM CHARACTERISTICS OF SUPERSONIC AIRCRAFT [BALANSIROVOCHNYYE KHARAKTERISTIKI SVERKHZVUKOVYKH SAMOLETOV]
S. Yu. Skripnichenko 27 Apr. 1967 21 p refs Transl. into ENGLISH from Izv. Vysah. Ucheb. Zaved., Aviats. Tekh. (Kazan), no. 1, 1966 p 16–27
(Contract AF 33(657)-16408)
(FTD-HT-66-788; AD-660764)

A comparative study of various supersonic aircraft configurations such as conventional delta wing, fixed and free-floating canard types is presented with respect to their trimming characteristics. The influence of various characteristic parameters of an aircraft on the magnitude of trimming lift coefficients and of required relative longitudinal control surfaces is analyzed in detail. A comparison of trimming methods using foreplane and tail surfaces with maximum lift coefficient increments shows the advantage of foreplane surfaces. The results from calculating required relative longitudinal control surfaces with equal trim parameters for landings of various aircraft configurations are given in graphs. The effect of boundary layer control on the magnitude of the required control surface is considered. On the basis of the results of the investigations discussed, it appears that a canard type configuration with application of boundary layer control is the best aerodynamic solution with respect to obtaining an optimal lift coefficient under trimming conditions during takeoffs and landings. TAB

N68-12224# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A METHOD FOR MEASURING THE VERTICAL VELOCITY OF AN AIRCRAFT IN THE ENTIRE FREQUENCY SPECTRUM OF ITS VARIATION [SPOSOB IZMERENIYA VERTIKAL'NOY SKOROSTI SAMOLETA VO USEM SPEKTRE CHASTOT YEYE IZMENENIYA]
L. A. Pakhomov 16 Jun. 1967 28 p refs Transl. into ENGLISH from Tr. Tsentr. Aerolog. Observ. (Moscow), no. 55, 1964 p 3–17
(FTD-MT-66-26; AD-661031)

The shortcomings of the G-load variometer and integrator, which presently are the only instruments for measuring the vertical velocity of an aircraft, are considered. It is shown that when these instruments are united into one system it is possible to solve the problem of measuring the vertical velocity of an aircraft in the entire frequency spectrum of its variation. A concrete diagram of this type of system is described. Author (TAB)

N68-12243# Therm Advanced Research, Inc., Ithaca, N. Y.
EXPERIMENTAL STUDY OF PILOT VISIBILITY FROM A VTOL AIR/SEA CRAFT NEAR THE OCEAN SURFACE
Patrick M. Tan, Richard W. Hale, and Donald E. Ordway Jul. 1967 39 p refs
(Contract N00014-66-C-0320)
(TAR-TR-6704; AD-661253)

A major problem associated with the operation of a VTOL air/sea craft near the ocean surface is the impairment of pilot visibility. Clouds of spray, generated by downwash impingement on the water surface, surround the aircraft and block the pilots view. The objective of the study was to determine promising methods for alleviating the problem. A model-scale experimental facility was constructed to study the details of spray generation and the characteristics of the resulting spray pattern. Several spray alleviation devices were then designed and tested. To evaluate their effectiveness, a technique for quantitative measurement of visibility was developed. Comparative tests were conducted with and without the spray alleviation devices. Author (TAB)

N68-12274# Aerodynamische Versuchsanstalt, Gottingen (West Germany).
PROBLEMS IN GROUND VIBRATION TESTING OF AIRCRAFT [ZUR PROBLEMATIK DES STANDSCHWINGUNGSVERSUCHS AN FLUGKOERPERN]
H. Foersching Oct. 1967 41 p refs In GERMAN; ENGLISH summary
(AVA-FB-6706) CFSTI: $3.00

The report contains the present stage, the importance and some special problems in ground vibration testing of aircraft. Referring to the well-known linearized equations for the numerical treatment of aeroelastic problems, the test methods and test procedures were explained and some recent developments were shortly discussed. Some special elastomechanical properties of aircraft, such as nonproportional distribution of structural damping, structural asymmetries and non-linearities of the structure have been investigated, and the resulting difficulties in measuring the dynamic parameters of the aircraft were shown. Finally, it is referred to the importance and the special problems of the ground vibration test on space vehicles. Author

N68-12278 Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
TEMPERATURE PROBLEM CONCERNING THE STRUCTURE OF VTOL JET TRANSPORT [TEMPERATURPROBLEME AN DER STRUKTUR VON VTOL-STRAHLTRANSPORTERN]

M. Flemming and D. Rose Oct. 1967 46 p refs In GERMAN Presented at WGLR/DGRR Ann. Meeting, 1967
CFSTI: $3.00

The effects of the temperature field, created during starting and landing phases of VTOL aircrafts, on structural and engine design configurations are evaluated. Temperature measurements on scale lifting models and aircrafts with turbine engines found a fire problem caused by heat expansion of the nozzle skirt and the escape of hot air from the turbine jet. Additional side vent installations lowered the jet temperature and prevented structural overheating.
Transl. by G.G.

N68-12285# Western Co. of North America, Dallas, Tex.
INVESTIGATION OF HYDRAULIC POWER TRANSMISSION SYSTEMS FOR V/STOL AIRCRAFT Final Report
Jerome L. Overfield and Horace R. Crawford Aug. 1967 84 p refs
(Contract DA-44-177-AMC-333(T))
(USAAVLABS-TR-67-40; AD-661311)

A comparison is presented between the efficiency and weight of the UH-1 helicopter gear transmission and speed reducer systems to a hydraulic power transmitting system for the UH-1. The hydraulic transmission system is composed of a turbine speed hydraulic pump and a hydraulic motor. The hydraulic transmission system utilizes recently developed non-Newtonian, viscoelastic fluids which greatly reduce fluid friction losses, increase hydraulic component volumetric efficiency, and allows a substantial reduction in connecting fluid line sizes without the usual high fluid friction losses which normally result from use of small lines. The results of the comparison show the hydraulic transmission system efficiency closely matches the gear system efficiency, and the hydraulic transmission system is lighter than the gear system. A limited aircraft effectiveness study shows that the flexibility of design which is possible with a hydraulic transmission can result in an increase in useful engine horsepower, reduced infrared signature, improved foreign object damage protection and a reduction in engine/airframe vibration. The hydraulic transmission system is based upon hydraulic components which were chosen from an industry and government agency wide search for the best hydraulic components. Design data and calculated and test performance are shown for the hydraulic components. Test data is shown for the fluid flow friction reducing hydraulic fluid. Vulnerability, maintenance, logistics and operational considerations for a hydraulic transmission are presented.
Author (TAB)

N68-12297 Deutsche Airbus G.m.b.H., Munich (West Germany).
THE EUROPEAN AIRBUS A-300 (GENERAL INTRODUCTION) [DER EUROPAEISCHE AIRBUS A-300 (ALLGEM. EINFUEHRUNG]
Hans Wocke [1967] 26 p In GERMAN Presented at WGLR/DGRR Ann. Meeting, Karlsruhe, West Germany, Oct. 1967
(Rept.-6) CFSTI: $3.00

Economic and general transportation problems in the development of a medium range large passenger aircraft are depicted. This proposed 2 motor configuration will be able to carry 267 to 298 persons over distances of 2300 to 3100 km, will reach a speed of about 924 km/h, and will be serving internal European traffic.
Transl. by G.G.

N68-12298 Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
INFLUENCE OF ACCESSIBILITY AND RELIABILITY ON THE USAGE AND THE OPERATIONAL COSTS OF COMMERCIAL AIRPLANES [EINFLUSS VON WARTBARKEIT UND ZUVERLAESSIGKEIT AUF DEN EINSATZ UND DIE BETRIEBSKOSTEN VON VERKEHRSFLUGZEUGEN]
J. Spintzyk and K. B. Brink Sep. 1967 78 p refs In GERMAN Presented at WGLR/DGRR Ann. Meeting, Karlsruhe, West Germany, Oct. 1967
(Rept.-67/26-EP10)

The effects of various design parameters on the profit potential of commercial aircraft is evaluated statistically by considering maintainability and dependability of the various components. Reliability aspects from the development phase through actual flight performance are analyzed with emphasis on required grounding times in relation to actual flight times; delayed starts have the most pronounced negative effect on the earning power of the aircraft.
Transl. by G.G.

N68-12302# Entwicklungsring Sud, Munich (West Germany).
DETERMINATION OF THE MANEUVERING LOAD OF AIRCRAFT USING DILATOMETER STRIPS [ERMITTLUNG DER MANOEVERLASTEN VON FLUGZEUGEN MIT HILFE VON DEHNUNGSMESSSTREIFEN]
Erwin Schneider Sep. 1967 68 p refs In GERMAN Presented at WGLR/DGRR Ann. Meeting, Karlsruhe, West Germany, Oct. 1967
(EWR-SB-9-67; Rept.-78; DIN-A4) CFSTI: $3.00

Calibration of wire strain gauge installations in aircraft structures for flight load measurements is obtained by considering the shear force, bending moment, and torsion moment acting on the structural point under consideration. Combined measurements from a small number of similar gauges with proportional load signals and their evaluation by the least squares method reduces the overall measurement calibration effort and simplifies procedures substantially.
Transl. by G.G.

N68-12368# Army Aeromedical Research Unit, Fort Rucker, Ala.
IMPROVING HELICOPTER CONSPICUITY THROUGH THE USE OF PAINTED MAIN ROTOR BLADES
John K. Crosley, Robert W. Bailey, and M. S. Nix, Jr. Oct. 1967 15 p refs
(USAARU-68-2; AD-661067)

An in-flight study was conducted to determine the effect of four paint schemes, applied to the main rotor blades of UH-1D helicopters, upon helicopter conspicuity. Twenty-three observers made a total of 138 comparisons of paired aircraft. The preferred scheme incorporated white, red-orange fluorescent, and black paints.
Author (TAB)

N68-12447 Aeronautical Research Council (Gt. Brit.)
SOME CALCULATIONS OF THE TAKE-OFF BEHAVIOR OF A SLENDER-WING SUPERSONIC TRANSPORT DESIGN CONSTRAINED TO FOLLOW A SPECIFIED PITCH-ATTITUDE TIME HISTORY
B. N. Tomlinson and M. Judd 1967 48 p refs Supersedes RAE-TR-65174; ARC-27372
(ARC-R&M-3493; RAE-TR-65174; ARC-27372) CFSTI: $3.00

The rotation and flare-up phases of the take-off of a slender-wing supersonic transport aircraft are studied by calculating the time histories of speed, height etc. when the pitch-attitude time history is specified. The shape of the attitude function is fixed but its maximum attitude and duration, and the rotation speed at which it starts, may be varied to show the effect on the performance of variations in the take-off procedure. Both three and four engine take-offs are examined and the influence of the ground on lift, drag and pitching moment is included. Only small variations in achieved rotation and unstick speeds can be permitted if low climb gradients or large take-off distances are to be avoided. Low rotation rates of about 1–2 deg/sec are preferable.
Author

N68-12458 Aeronautical Research Council (Gt. Brit.)
FLIGHT DETERMINATION OF WING FLOW PATTERNS AND BUFFET BOUNDARIES FOR THE FAIREY DELTA 2 AIRCRAFT AT MACH NUMBERS BETWEEN 0.4 AND 1.3, AND COMPARISON WITH WIND TUNNEL RESULTS
F. W. Dee and O. P. Nicholas 1967 45 p refs Supersedes RAE-TR-64012; ARC-26600
(ARC-R&M-3482; RAE-TR-64012; ARC-26600) CFSTI: $3.00

Tests have been made, using surface tufts, to visualize the flow over the wing of the Fairey Delta 2 at Mach numbers 0.4 and 1.3, for a range of normal-force coefficients. The results indicate that a leading-edge vortex, accompanied by an area of secondary separation at the wing-tip, is present under most flight conditions. Diagrams of the flow patterns are presented, and compared with wind-tunnel tests, again using surface tufts, on a 1/9 scale model in the R.A.E. Bedford 8 foot×8 foot wind tunnel. It is shown that the same general flow characteristics exist in flight and wind-tunnel tests, but that at subsonic speeds and low incidences the vortex origin is further inboard in the tunnel than in flight. The buffet boundaries were also determined and there is reasonable correlation between the buffet onset and the existence of a significant area of wing-tip separation. Author

N68-12584# Arizona State Univ., Tempe. Aviation Safety Engineering and Research, Phoenix, Ariz.
AIRCRAFT PASSENGER-SEAT-SYSTEM RESPONSE TO IMPULSIVE LOADS
James W. Turnbow, Jack A. Collins, J. Robert Cromack, and Nils P. Myklestad Fort Eustis, Va. Army Aviation Mater. Labs. Aug. 1967 314 p refs Prepared jointly with Aviation Safety Eng. and Res.
(Contracts DA-44-177-AMC-254(T); DA-44-177-AMC-360(T))
(AVSER-66-20; USAAVLABS-TR-67-17; AD-661088)

The report is divided into four chapters. Chapter 1 describes the mathematical model consisting of a visco-elastic occupant (control of joint stiffness through muscle tension) and an elastic–plastic seat structure. A comparison is made of the computer output and a full-scale dynamic test of a modern transport seat using instrumented dummies. Chapter 2 presents a spectrum of design data based on results obtained from the computer program. Chapter 3 presents a discussion of load limiting and other structural and detail design concepts appropriate to maintaining good restraint of the occupant. Stress concentrations under dynamic load are explored, and the results of experimental tests are presented to show that components which have stress raisers may absorb only very small amounts of energy prior to failure. Chapter 4 discusses the problem of head impact for the jackknifing passenger when restrained by seat belt alone. A computer study has been made which allows a correlation of head impact velocity and 'cushioning material' thickness with the presently known human tolerance limits to deceleration. It is shown that the permissible head impact velocities will probably be in the order of one-third to one-half those which result in 64-foot-per-second impacts. Author (TAB)

N68-12694 France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
THE THEORY OF THE SUPERSONIC BOOM FROM THE NONLINEAR THEORY OF SHORT WAVES [LA THEORIE DU BANG SUPERSONIQUE D'APRES LA THEORIE NON LINEAIRE DES ONDES COURTES]
Jean-Pierre Guiraud 1967 24 p refs Presented at the Franco-Ger. Colloq. on the Bang of Supersonic Airplanes, Saint-Louis, 18–20 Oct. 1967
(TP-521(1967))

Mathematical models are evolved for determining various theoretical aspects of supersonic boom through the use of nonlinear theory related to short waves. These equations deal with perturbations near certain wave surfaces, rigidness of signals due to nonlinear effects, and dispersion and diffusion of waves due to viscous dissipation and thermal conductivity. A brief note on related studies in the literature is included. Transl. by M.W.R.

N68-12742 National Physical Lab., Teddington (England). Aerodynamics Div.
INTERIM PROPOSAL FOR AIR ATTENUATION VALUES FOR AIRCRAFT NOISE
D. W. Robinson and W. C. T. Copeland 14 Jul. 1967 20 p refs
(NPL-AERO-AC-28; ARC-29276) CFSTI: $3.00

Evidence has accrued that laboratory-acquired data on the absorption of sound in air lead to overestimates of atmospheric attenuation of aircraft jet noise in the frequency region above about 4 kHz. This report proposes interim provisional values, based on limited observations on actual aircraft, for octave and 1/3-octave bands from 2–10 kHz, intended primarily for noise certification of aircraft. Author

N68-12794 Royal Aircraft Establishment, Farnborough (England).
KLM—RESEARCH ON THE LOWERING OF WEATHER MINIMA FOR LANDING OF AIRCRAFT [KLM—STUDIES BETREFFENDE DE LANDING VAN VLIEGTUIGEN BU LAGE WEERSLIMIETEN]
C. H. Reede Aug. 1967 35 p Transl. into ENGLISH from Ing. (The Hague), v. 77, no. 11, 1965 p L1–L13 Presented at the Netherlands Soc. for Aeron., Amsterdam, 18 Jun. 1964
(RAE-LIB-TRANS-1250) CFSTI: $3.00

The feasibility and adequacy of giving the pilot of a large jet aircraft final approach and flare-out guidance by means of a head-up display driven by a flare-out computer, is studied. To obtain an insight in the way a pilot lands a large jet aircraft, a number of normal landings with a DC 8 were recorded. Results of this part of the program are given and tentative conclusions on the normal way a DC 8 is landed are drawn. These results are used to assess the acceptability to the pilot of the experimental flare-out guidance equipment installed and flight tested in the aircraft later, viz. a Smiths PVD head-up display driven by a Smiths flare-out computer. The system is discussed and the method in which it was adjusted during a test flight is described. A few results of the very limited amount of experience with the system during line flights are given. Results appear promising. Author

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N68-11920*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL PERFORMANCE EVALUATION OF A 6.02-INCH (15.29-CM) RADIAL-INFLOW TURBINE WITH AN EXIT DIFFUSER

Samuel M. Futral, Jr. and Donald E. Holeski Washington Dec. 1967 17 p refs
(NASA-TM-X-1480) CFSTI: HC $3.00/MF $0.65 CSCL 10A

The evaluation used argon as the working fluid and covered a range of speeds and pressure ratios. Turbine inlet conditions were fixed at values corresponding to design Reynolds number for design equivalent speed and design pressure ratio operation. Results of the investigation indicated that, at design equivalent speed and pressure ratio, the turbine static efficiencies before and after diffusion were 0.825 and 0.865, respectively. The results also indicated a decrease in total efficiency of approximately 2 percent across the diffuser with the leaving loss accounting for less than 1 percentage point in the efficiency. The ratio of diffuser static pressure recovery to the diffuser inlet impact pressure was approximately 0.6. This recovery is about 71 percent of the isentropic incompressible value for the same area ratio. Author

N68-12017# Eagle-Picher Co., Joplin, Mo. Couples Dept.
MAGNESIUM/MAGNESIUM-PERCHLORATE MANGANESE DIOXIDE BATTERIES FOR FIELD RADIO APPLICATIONS Technical Report, Oct. 1966–Aug. 1967
Earl B. Cupp Nov. 1967 34 p
(Contract DAAB07-67-C-0116)
(Rept.-1; ECOM-0116-1; AD-661069)

The report describes the significant accomplishments made toward meeting the design goals for the type 62 battery. The design effort directed toward lighter battery weight, nonspill features, activated storage and control of battery expansion are described in detail. The report concludes with a final 6.5 pound battery design which should meet the requirements for the type 62 battery. Author (TAB)

N68-12022# Marathon Battery Co., Wausau, Wis.
DEVELOPMENT OF IMPROVED ZINC BATTERIES FOR HIGH TEMPERATURE STORAGE Final Report, 1 Jun.–1 Aug. 1967
George H. Schroeder Nov. 1967 33 p
(Contract DA-28-043-AMC-02534(E))
(ECOM-02534-F; Rept.-2; AD-661306)

The report describes results obtained in an effort to improve the high temperature storageability of cylindrical zinc-MnO2 Le Clanche cells. Reference is made to the causes of break down at elevated temperatures as well as to the efforts made to eliminate them. Author (TAB)

N68-12040# Engelhard Industries, Inc., East Newark, N. J. Research and Development Div.
EVALUATION OF PHOSPHORIC ACID MATRIX FUEL CELLS Semiannual Report
O. J. Adlhart and V. V. Tanna Aug. 1967 38 p
(Contract DAAK02-67-C-0219)
(SAR-1; AD-661101)

The performance characteristics were established for a state of the art H3PO4 matrix fuel cell developed for operation with steam reformate (3% CO) and air. The testing demonstrated the compatibility of the presently used cell components over long periods of time in the 160-190C temperature range. Initial power densities of about 60 W/sq. ft. at .70 volt terminal voltage using a total platinum loading of 11.5 g/sq. ft. Significant performance degradation was observed, however, particularly in the first 300-400 hours under cell operating conditions. This performance decay was traced to two major factors, namely, recrystallization of the cathode catalyst, and marked increase in matrix electrolyte resistance. No evidence was found for a performance degradation related to porosity changes in the porous metallized teflon used as an electrode substrate or in the catalyst layer itself. TAB

N68-12046# Aerospace Corp., El Segundo, Calif.
POWER CONDITIONING FOR SATELLITE SYSTEMS (A SYSTEM POWER CONDITIONING PRIMER)
Stanley Pro Mar. 1967 83 p ref
(Contract AF 04(695)-1001)
(TR-1001(2307)-6; SAMSO-TR-67-10; AD-660532)

The basic building blocks of a power conditioning system are discussed. Design configurations, trade-off studies, and application information are presented on various basic regulator, converter, and inverter circuits. How these basic building blocks are formed into optimum systems is illustrated and a number of typical examples of system requirements and how they can be met are presented. Author (TAB)

N68-12150# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
CHARACTERISTICS OF HERMETICALLY SEALED NICKEL CADMIUM BATTERIES
L. Wilson Aug. 1967 46 p refs
(Contract NOw-62-0604-c)
(TG-942; AD-661215)

The report summarizes basic thermodynamics, electrochemistry, and internal energy losses of satellite nickel cadmium batteries presently in use by APL. Dependence of electrical parameters (i.e., capacity, voltage, and current) on temperature and loads is reviewed from a users point of view and generally reflects APLs experience in this area. Recommendations and guide lines are included for use in the design of a battery geared to operate for over two years in orbit. Author (TAB)

N68-12252*# Radio Corp. of America, Lancaster, Pa.
SOLAR THERMOELECTRIC GENERATOR DESIGN AND PANEL DEVELOPMENT PROGRAM
V. Raag, R. E. Berlin, and L. H. Gnau 20 Dec. 1967 122 p refs
(Contract NAS3-10600)
(NASA-CR-72340; RCA-647DR-1220) CFSTI: HC $3.00/MF $0.65 CSCL 10B

A silicon–germanium solar thermoelectric generator has been designed for operation at a distance of 0.25 AU from the sun. The generator delivers 150 watts of electrical power at a nominal load voltage of 28 volts; produces 36.4 watts per square foot of generator area; and weighs 3.23 pounds per square foot. The design and analysis of both thermoelectric and mechanical performances of this generator are considered in detail. Engineering layout drawings of the generator and its components are also presented. Author

N68-12303 Siemens-Schuckertwerke A. G., Erlangen (West Germany). Forschungslaboratorium.
SOLAR CELLS FOR ENERGY PROVISION OF UNMANNED SATELLITES [SOLARZELLEN ZUR ENERGIEVERSORGUNG UNBEMANNTER SATELLITEN]
Erich Nitsche [1967] 22 p refs In GERMAN Presented at WGLR/DGRR Ann. Meeting, Karlsruhe, West Germany, Oct. 1967

Development and evaluation of n/p silicon barrier solar cells are reported. Current voltage curves of 2×2×0.03 cm silicon–boron cells under simulated solar radiation at 80°C established firmly the temperature depencence of the silicon semiconductor; short circuit current increased with 0.06%/°C, the no-load voltate with 0.4%/°C, and maximal output decreased with 0.5%/°C content. Silicon solar cells of 2×2 cm dimensions and with a high blue light sensitivity reached median current output of about 58 mW under extraterrestrial sun light simulation. Transl. by G.G.

N68-12477# Jackson and Moreland, Inc., Boston, Mass.
REVIEW AND EVALUATION OF PROJECT FUEL CELL
H. F. White Dec. 1966 105 p
(Contract DI-14-01-001-500)
(OCR-17; PB-173765) CFSTI: HC$3.00/MF$0.65

Progress is reported in the development of a high efficiency, coal oxidation, solid electrolyte fuel cell. The technical potential of the fuel cell is evaluated, and a research program required to establish commercial feasibility is projected. Cost estimates are prepared for the research program including equipment, data collection, and evaluation of each work phase. The first commercial use of the fuel cell power system is projected, and a potential application is described which includes capital investment, operating costs, efficiency, and power cost. A compilation of report abstracts that were generated as a result of the study is included. C.T.C.

N68-12668# California Univ., Berkeley. Lawrence Radiation Lab.
EFFECT OF PERIODIC MENISCUS DISPLACEMENTS ON THE PERFORMANCE OF POROUS GAS ELECTRODES
Jean-Pierre Roussillon (M.S. Thesis) Aug. 1967 97 p refs
(Contract W-7405-ENG-48)
(UCRL-17594) CFSTI: HC$3.00/MF$0.65

The influence of periodic movement of the gas–electrolyte interface in a film-type porous gas electrode was studied experimentally for the oxygen cathode in 2N KOH electrolyte. A single silver capillary tube of 150-μ ID was used as a cathode. The interface motion was obtained by displacement of the electrolyte in a closed compartment by a small piston driven mechanically at controlled frequency and amplitude. Measurements of the response of the cathode potential relative to the mercury/mercuric oxide reference electrode were made under galvanostatic conditions. Qualitative effects of the meniscus movement were characterized by a periodic response of the cathode potential of a few millivolts amplitude. These effects indicated a decrease in overpotential during the advance of the meniscus toward the gas filled portion of the capillary, and an increase during motion in the opposite direction.
Author (NSA)

N68-12891# Argonne National Lab., Ill.
ANION-EXCHANGE BEHAVIOR OF LIGHT RARE EARTHS IN AQUEOUS METHANOL SOLUTIONS CONTAINING NEUTRAL NITRATES. 2: MACRO–MICRO SEPARATIONS
F. Molnar, A. Horvath, and V. A. Khalkin Jul. 1967 9 p refs Transl. into ENGLISH from Bronnst.-Waerme-Kraft (Germany), v. 17, 1965 p 13–16
(ANL-TRANS-508) CFSTI: HC$3.00/MF$0.65

It has often been proposed that a liquid metal stream driven by a vapor stream of the same metal to high velocity be used for the application in MHD generators. The theoretical possibility of such an ejector was investigated from thermodynamical and fluid mechanical view points. The results indicate that the maximum of the attainable thermal efficiency is very low. Author (NSA)

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N68-11942# Aerospace Medical Div. Aeromedical Research Lab. (6571st), Holloman AFB, N. Mex.
IMMEDIATE BEHAVIORAL DETECTION OF X-RAYS BY THE RHESUS MONKEY Final Report, Period Ending Jul. 1967
Henry L. Taylor, James C. Smith, and C. Ann Hatfield Oct. 1967 19 p refs Prepared jointly with Fla. State Univ., Tallahassee
(Contracts F29600-67-C-0012; AT(40-1)-2903; AT(40-1)-2690)
(ARL-TR-67-20; AD-660580)

Immediate detection of X-rays (.63r/sec.) in four rhesus monkeys was demonstrated through the use of the conditioned suppression technique. Detection was evident in three monkeys after 20 trials in which X-rays and unavoidable shock were paired, and after 5 trials of pairing X-rays and shock for one monkey. Dose rate was decreased to .03r/sec. and all subjects showed a high level of response suppression in the presence of X-rays, but no suppression of response was evident during control trials.
Author (TAB)

N68-11968*# Dudley Observatory, Albany, N. Y.
THE MICROBIOLOGICAL FLORA OF THE GEMINI 9 SPACECRAFT BEFORE AND AFTER FLIGHT
John Hotchin (N. Y. State Dept. of Health), Peter Lorenz, Aletha Markusen (N. Y. State Univ., Albany), and Scott Covert (Albany Med. Coll., N. Y.) Washington NASA Dec. 1967 16 p refs
(Grant NsG-155)
(NASA-CR-972) CFSTI: HC$3.00/MF$0.65 CSCL 06M

Three sites within the Gemini IX space capsule were investigated for microbiological contamination by swabbing before and after the flight. Bacterial or mold growth was observed in three sets of swabs taken before the flight and one set of swabs taken after the flight, and most of the swabs were then found heavily covered with dust. The results were obtained by the completely independent study of the eluted suspensions of the swabs by three research groups and, despite the considerable variation of the detailed results, they show that the inside of the Gemini IX space capsule was contaminated with microbiological materials both before and after the flight. Author

N68-12075# School of Aerospace Medicine, Brooks AFB, Tex.
HEARING OF FLYING PERSONNEL: 1962 TO 1965
Harrell C. Sutherland, Jr., James E. Endicott, and Frederick G. Collins Jun. 1967 22 p refs
(SAM-TR-67-56; AD-660558)

A survey was made of pure-tone threshold audiograms of 2,246 flyers (pilots, navigators, and others) who were tested at the School of Aerospace Medicine during the years 1962 to 1965. Hearing levels were tabulated by percentiles for each age range, at eight audiometric frequencies and for right and left ear separately. These hearing levels were compared to those of another group composed of Air Force pilots only (tested during the years 1955 to 1962) and to hearing levels of the adult, male population of the United States as reported by the National Center for Health Statistics. The results indicate that hearing acuity decreases with age and increased pure-tone frequency (except at 8000 Hz), and that flyers have better hearing than does the general population but tend to lose hearing more rapidly at 6000 Hz. Author (TAB)

N68-12084*# California Univ., Berkeley. Space Sciences Lab.
MOLECULAR BIOLOGY AND GENETICS
T. H. Jukes *In its* Ann. Conf. of Episcopal Cathedral Deans Apr. 1967 p 25–39 (See N68-12081 03-34)

Research landmarks on deoxyribonucleic acid (DNA) are reviewed, along with various genetic concepts. The structure of part of a DNA molecule is depicted to illustrate the phenomenon of hydrogen bonding, and to show how one molecule could carry all

the information for all forms of life from generation to generation starting with the vary origin of life itself. It is also shown how one DNA molecule can produce two, each of which is identical with the parent. The three main types of ribonucleic acid (RNA) and their three separate functions are discussed, and the 20 amino acids concerned in the synthesis of proteins are listed. Attention is also centered on the genetic code, or the translation procedure by which the four-letter language of DNA is translated into the 20-letter language of the proteins. The impact of such findings on the concept of evolution is discussed, and several examples of mutations that take place in DNA molecules are given. M.G.J.

N68-12097# Wisconsin Alumni Research Foundation, Madison.
DEVELOPMENT AND EVALUATION OF A PELLETED AND TABLETED DIET FOR CHIMPANZEES Final Report, Apr. 1966–Feb. 1967
E. S. Robaidek, Philip H. Derse, Leonard Regel, and Paul O. Nees Holloman AFB, N. Mex. Aeromed. Res. Lab. Oct. 1967 82 p refs
(Contract AF 29(600)-5181)
(ARL-TR-67-21; AD-660862)

Eleven modifications of the Wisconsin Alumni Research Foundation (WARF) chimpanzee diet were evaluated for nutritional adequacy during a 9 month feeding period. Six 18-36 months old chimpanzees of both sexes were used. Daily food intake and bi-weekly body weights were obtained. Hematological studies, and biochemical determinations of serum, urinary and fecal constituents were made at regular intervals during the course of the study. Fecal bacteria measurements at selected intervals were also made. Feed palatability and fecal consistency were evaluated. All modifications of the diet were found to be adequate in providing the basic nutritional requirements of the animals, with the exception of vitamin C, which was partially lost in pelleting of the diets. A formulation was made which could be satisfactorily tableted for use in dispensing machines. The same formulation was the most palatable and produced a very satisfactory fecal consistency. Suggestions for improving vitamin C stability in the pelleted diets were made. Author (TAB)

N68-12151 India. Dept. of Atomic Energy, Bombay.
BIOCHEMICAL EFFECTS OF IONISING RADIATIONS
A. Sreenivasan 1967 29 p
(BARC-287) CFSTI: $3.00

Radiobiological damage effects to various organisms at molecular or chemical levels are reviewed. Radiation effects on cells are investigated. Data tables summarizing these effects include: development of radiation injury, half-inactivation dose for various microorganisms, dosage for 50 percent deaths in 30 days (X-rays), survival of mice after 1025 r of X-rays, radiation damage to DNA in aqueous environment, possible post-irradiation DNA repair mechanisms, effect of homologous and heterologous native DNA preparations on the survival of lethally irradiated rats, effects of administered DNA on ability of bone marrow cells to synthesize DNA, urinary taurine after whole body X-irradiation of rats, X-irradiation and *in vivo* administration of ascorbic acid on CF synthesized by rat bone morrow, X-irradiation on rat tissue folates, radiation effect on survival of *s. cerevesiae* and catalase induction, induced catalase synthesis and dose modifying effect of prior aeration, and irradiated sucrose solution effect on oxidative metabolism in rat liver mitochondria. E.C.

N68-12158# Honeywell, Inc., St. Paul, Minn.
LASER RADIATION EFFECTS ON THE MORPHOLOGY AND FUNCTION OF OCULAR TISSUE Annual Report
Arthur E. Jones and David D. Fairchild Aug. 1967 52 p refs
(Contract DADA-17-67-C-0019)
(Doc.-12047-TDRI; AR-1; AD-661094)

A study was made of the effects of laser radiation on the structure and function of the primate retina. The program encompasses the ocular effects of pulsed and CW laser radiation through: (1) Anatomical studies of laser-exposed and non-exposed tissue at the resolution of both light and electron optics. These are directed toward studies of the chemical morphology of retinal structures through enzyme and other staining techniques. (2) Analysis of bioelectric potentials in the visual system. The electroretinogram recorded from the intact eye is used to follow long-term effects of laser radiation. The LERG (localized electroretinogram) will be used to study localized effects of laser radiation. Single unit recording from the fourth-order neurons (LGN) of the visual system will be used to study photochemical effects of laser radiation. (3) Laser-induced changes in retinal metabolism are being investigated through autoradiographic studies of C14 labeled vitamin A. (4) Laser exposures of the macula of rhesus and mangebey monkeys are made in conjunction with ERG studies. These animals are trained to perform in testing apparatus and are tested for visual defects. Author (TAB)

N68-12219# Pittsburgh Univ., Pa.
EFFECTS OF CERTAIN COMPOUNDS ON ANIMALS SUBJECTED TO SIMULATED HIGH ALTITUDE Annual Progress Report, Feb. 1–Oct. 1, 1967
Joseph P. Buckley Oct. 1967 8 p
(Contract DADA-17-67-C-7089)
(APR-1; AD-661059)

The studies were mainly concerned with the possible mechanisms of action of the compound in protecting the animals from the lethal effects of severe hypoxia and the design and manufacture of a decompression chamber which would permit utilization of four Skinner boxes to determine the effects of phenformin HCl on performance and learning at simulated high altitude. Author (TAB)

N68-12300# Joint Publications Research Service, Washington, D. C.
PHYSIOLOGICAL STUDIES IN EMOTIONAL AND MENTAL STRESS
A. I. Kikolov 13 Dec. 1967 119 p refs Transl. from the book "Umstvenno-emotsional'noye Napryazheniye za Pul'tom Upravleniya" Moscow, Meditsina p 7–25, 42–162, 171–175
(JPRS-43700) CFSTI: HC $3.00/MF $0.65

A literature survey was conducted on the physiological and emotional effects of work assignments involving the use of automatic equipment containing control boards. Emphasis is placed on determining optimum work and rest cycles. Functional states of various organs and systems in humans engaged in mental work are reviewed. A lengthy study is described based on the working conditions of the following control board operators: television studio personnel, testers in the aviation industry, and monitors and dispatchers in air, rail, and subway systems. A second study further examines the work processes of television studio and rail transport personnel. E.C.

N68-12310*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ENVIRONMENTAL REQUIREMENTS
In its Space Programs Sum. No. 37-47, Vol. 3 31 Oct. 1967 p 31–35 refs (See N68-12306 03-30)

An investigation is made of the effects of microbial load distribution on the heat sterilization of spacecraft. A conceptual analytic model was constructed that consists of a cylinder 8 ft. in radius and 16 ft. high, of homogeneous material and insulated at the ends. This model was selected so that a thermal analysis could be easily performed, and it is assumed that the model could be divided into zones or shells of constant altitude. It is shown that the microbial distribution on the spacecraft may significantly affect

the calculation of the required process parameters. It is also shown that the interrelationship between microbial distribution and thermal characteristics of the spacecraft may result in the use of a zone other than the most heat-resistant zone for establishment of process parameters. C.T.C.

N68-12322*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
BIOSCIENCE
In its Space Programs Sum. No. 37-47, Vol. 3 31 Oct. 1967 p 189-197 refs (See N68-12306 03-30)

Planetary research is reported in (1) metabolic activities of an osmophilic yeast relative to a study of limitations of water on growth and metabolism and (2) a pyrolysis-infrared analysis of selected soils and natural materials. In the first area determinations were made of the difficulties encountered in measuring the activities of *Saccharomyces mellis* whose metabolism is functional at low water activities such as is indicated on the surface of Mars. In the second area the pyrolysis-infrared method was applied to soils that differ in organic content and to artificial soils composed of mixtures of selected natural materials with ignited soils. Results suggest that soils can be distinguished from one another in this way and that some of the classes of organic compounds that make up a soil can be identified. C.T.C.

N68-12336# School of Aerospace Medicine, Brooks AFB, Tex.
THE EFFECTS OF MONOMETHYLHYDRAZINE ON THE COAGULATION MECHANISM
Jarrell D. Bairrington Jul. 1967 11 p refs
(SAM-TR-67-64; AD-660560)

The in vivo effects of a 0.6 LD50 dose of monomethylhydrazine (MMH) on the prothrombin-activating mechanism and the fibrinolytic mechanism were studied in rats anesthetized with ether. The studies were evaluated by means of the prothrombin time, partial thromboplastin time, thromboplastin generation test, and quantitative measurements of free and total profibrinolysin, and the euglobulin inhibitor. No significant changes were found in the prothrombin time or partial thromboplastin time, but the thromboplastin generation time was increased ($P < .001$) and total profibrinolysin was decreased significantly ($P < .05$). The relationship of these changes with the effects of hydrazine is discussed. Author (TAB)

N68-12342*# Northrop Space Labs., Hawthorne, Calif.
A PROTOTYPE SPACE FLIGHT EXPERIMENT PACKAGE TO STUDY CIRCADIAN PERIODICITY IN POCKET MICE Final Report
Jun. 1966 58 p refs
(Contract NASw-1191)
(NASA-CR-91062; NSL-66-89) CFSTI: HC $3.00/MF $0.65 CSCL 06F

This report summarizes the development, testing and recommended modification of a Prototype Space Flight Experiment Package designed to conduct a study of the circadian periodicity of body temperature in the pocket mouse, *Perognathus longimembris*. The prototype has survived all environmental testing including vibration, acceleration, humidity, thermal and vacuum stresses. Experimental animals, with and without implanted telemeters, survived all parts of the environmental testing program pertinent to the experiment objectives. After thirty days of continuous operation in simulated space, there was no evidence of the package configuration affecting circadian periodicity in the mice. Author

N68-12376# School of Aerospace Medicine, Brooks AFB, Tex.
DIZZINESS AND VERTIGO IN AVIATORS
William L. Mitchell, Morgan E. Wing, and Frederick G. Collins Jul. 1967 18 p refs
(SAM-TR-67-60; AD-660559)

The medical records of 84 patients referred to the USAF School of Aerospace Medicine because of vertigo or diseases which are capable of producing vertigo are reviewed, and the findings and aeromedical disposition are analyzed. Approximately one-third of the patients evaluated in this series fell into the category of vestibular neuronitis. The remaining categories in order of decreasing frequency were Menieres disease, idiopathic paroxysmal vertigo, labyrinthine or central nervous system ischemia, trauma, barovertigo, and vertigo suspected to be due to neoplasm. Ten of the patients in this study were thought to have lightheadedness of nonvestibular origin. Author (TAB)

N68-12429# Florida State Univ., Tallahassee.
CRITICAL FUSION FREQUENCY IN RHESUS MONKEYS USING THE CONDITIONED SUPPRESSION TECHNIQUE Final Report for Aug. 1967
Stephen A. Shumake, James C. Smith, and Henry L. Taylor Holloman AFB, N. Mex. Aeromedical Res. Lab Oct. 1967 25 p refs Prepared jointly with Aeromedical Res. Lab.
(Contracts F29600-67-C-0012; AT (40-1)-2903)
(ARL-TR-67-22; AD-661298)

By using a modified conditioned suppression technique, critical fusion frequencies were determined across 8.0 log units of brightness for three rhesus monkeys. Threshold values ranged from 20 c.p.s. for -3.9 log ft. L. to 95 c.p.s. for 4.1 log ft. L. Although systematic individual differences were observed at each brightness value, the intrasubject variability did not exceed 5 c.p.s. upon replication. Author (TAB)

N68-12494*# General Technical Services, Inc., Upper Darby, Pa.
TRANSIENT BEHAVIOR OF ARTERIAL SYSTEMS IN RESPONSE TO FLOW PULSES
E. D. Young Washington NASA Dec. 1967 35 p refs
(Contract NASw-1066)
(NASA-CR-990) CFSTI: HC $3.00/MF $0.65 CSCL 06P

In this paper we hope to show the relation of transient analysis of fluid lines to harmonic analysis thereof, to indicate the practicality of formulating the transmission problem with respect to transients in the time domain and uniformly with respect to frequency or pulse width within the domain of linearity assumptions of Witzig, Iberall, Womersley, etc., to apply this transient analysis to a whole class of systems embracing in principle the normal range of mammalian arterial systems which should help to clarify the meaning of equivalence among various idealized models mentioned, to trace causual relations between familiar wave distortions seen in arterial trees and the basic geometry of the trees, or that of the equivalent system. Author

N68-12568* West Virginia Univ., Morgantown.
THE EFFECT OF CHANGING GRAVITY AND WEIGHTLESSNESS ON VASOPRESSIN CONTROL SYSTEMS Progress Report, 15 Feb.-14 Aug. 1967
Walter H. Moran, Jr. 14 Aug. 1967 9 p refs
(Grant NGR-49-001-019)
(NASA-CR-90750) CFSTI: $3.00 CSCL 06S

Efforts this period were devoted to increasing the accuracy of the antidiuretic hormone (ADH) assay method, to studying the ADH secretory response to stress in infants, to assaying plasma samples from Navy pilots in Vietnam for ADH content, to developing LINC-8 computer programs for analyzing the urinary conductance and urinary flow parameters of the rat ADH bioassay and for automatically controlling intravenous hydration of the rat biossay preparation, and to isolating CRF from rat plasma. A report on ADH blood levels in infants from birth to three months of age is appended. R.N.A.

N68-12569# Oak Ridge National Lab., Tenn.
EFFECTS OF IONIZING RADIATION ON INTERSPECIFIC COMPETITION
B. G. Blaylock [1967] 22 p refs Presented at 2d Natl. Symp. on Radioecol., Ann Arbor, Mich.
(Contract W-7405-ENG-26)
(ORNL-P-3063; CONF-670503-15)

The effect of acute and chronic radiation on competiton was studied in laboratory populations of the sibling species *Drosophila melanogaster* and *Drosophila simulans* that are similar both morphologically and genetically. *Drosophila simulans* was the superior species for thirty weeks in the control populations, but was eliminated by *D. melanogaster* when the populations were exposed to a chronic dose of 4.3 RADS/hr. After an acute dose of 2000 RADS, *D. melanogaster* was the superior species for approximately 12 weeks; however, the reverse was true when the populations were exposed to 10,000 RADS. *Drosophila melanogaster* was eliminated by *D. simulans* by the end of six weeks. The frequency of irradiated *D. melanogaster* or irradiated *D. simulans* (2000 RADS) decreased rapidly when placed in competition with non-irradiated flies of the opposite species. Under these conditions, irradiated *D. melanogaster* recovered after six weeks, but irradiated *D. simulans* never recovered and was eliminated in one population after 24 weeks. Population size was affected by the exposure to acute and chronic radiation, but most of the populations recovered after six weeks. The populations receiving 10,000 RADS were the exceptions; they required twelve weeks to recover. This was attributed to the effects of radiation on the reproductive capabilities of these species. After nine weeks of competition the populations having the largest average size were the ones that received an acute dose of 2000 RADS. Author (NSA)

N68-12649# Oak Ridge National Lab., Tenn.
ENVIRONMENTAL STUDIES: RADIOLOGICAL SIGNIFICANCE OF NUCLEAR ROCKET DEBRIS Progress Report, Jul. 1, 1965–Jun. 30, 1966
B. R. Fish, T. G. Clark, R. H. Boyett, W. H. Wilkie, Jr., and J. L. Thompson Dec. 1966 65 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1686) CFSTI: HC $3.00/MF $0.65

Radiological safety studies being conducted for the Space Nuclear Propulsion Office, Flight Safety Branch, are summarized for the period, July 1, 1965 to June 30, 1966. An assessment was made of the significance of radioactive debris that may enter the biosphere following accidental destruction of a nuclear propulsion system. The production and dosimetry of micron-size particles containing individual radionuclides or a spectrum of fission products were studied. Two dosimetric techniques were used to extrapolate to minute volumes of tissue the dose absorbed from small spheres of reactor fuel material. The first utilized an air ionization chamber. The second used a technique in which progressively smaller discs of an organic scintillator yield pulse height spectra. Spherical particles from 1 mm to 1 cm diameter were made in thermal gradient columns or in split molds of aluminum or teflon. Labeling of these sources was done by addition of radioisotopes to a uranium–carbon mix prior to insertion in the mold or by neutron irradiation following particle fabrication. Deposition and adhesion of radioactive debris on the skin were studied. The degree of initial retention on the arm of particles falling vertically in a uniform fallout was determined. Coated UC_2 fuel beads were used in tests to determine the initial deposition and retention time on the skin. A wide variation was noted between individuals in the average length of time these particles remained on the arm under identical environmental conditions. Skin decontamination experiments showed that simple sanitary habits suffice to remove particles ranging from 1 to 1000 microns in diameter. Preliminary determination of gastrointestinal tract transit time in man, using insoluble particles showed a significant fraction to be retained for periods longer than the 31-hour standard value. NSA

N68-12748 Joint Publications Research Service, Washington, D. C.
PROTECTION OF RESPIRATORY ORGANS AGAINST RADIOACTIVE SUBSTANCES
S. M. Gorodinskiy, T. N. Skvortsova, and V. L. Shcherbakov 5 Dec. 1967 10 p refs Transl. into ENGLISH from Gigena Truda i Prof. Zabolevaniya (Moscow), no. 9, 1967 p 13–16
(JPRS-43578)

The value of individual respirators for protecting the respiratory organs against radioactive substances is considered in terms of Soviet developments since 1960. Characteristics of three brands of Lepestok-type respirators are compared, and recommendations are offered for their uses. Mention is made of pneumatic suits and hose-type protective suits that have been used in industrial situations. M.W.R.

N68-12786# Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany).
ABNORMAL MOLECULES IN URINE AFTER IRRADIATION
Z. Dienstbier, M. Arient, and J. Shejbal Oct. 1966 29 p refs
(SZS-12(1966))

In a review of different catabolites, the excretion of which is quantitatively changed after irradiation, their importance for the diagnosis of postirradiation damage is discussed. Author (NSA)

N68-12789# Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany).
CHANGES IN THE BIOELECTRIC ACTIVITY OF THE BRAIN BY THE ACTION OF IONIZING RADIATION [VERAENDERUNGEN DER BIOELEKTRISCHEN AKTIVITAET DES GEHIRNS DURCH EINWIRKUNG IONISIERENDER STRAHLUNG]
J. Michel Sep. 1966 38 p refs In GERMAN; ENGLISH summary
(SZS-11(1966))

Experimental and clinical studies of radiation effects on brain electrical activity so far known in literature are surveyed and discussed with regard to evidence of radiosensibility of the brain and the usefulness of the surface EEG as a criterion for radiation-induced functional changes or damages to the CNS. The results demonstrate that even smallest radiation doses may cause transitory functional changes in the brain and that various structures of the brain obviously have a high selective radiosensibility. The difficulties in interpreting the changes of brain electrical activity caused by small and medium radiation doses are pointed out, especially with regard to the question when these changes must be considered a damage. The question, whether the surface-EEG is useful as a criterion for changes or early damages of the function of the brain caused by small and medium radiation doses cannot be answered by investigations to date with mainly conventional, qualitative EEG-analysis and its final clearing is reserved for further studies with objective, quantitative (automatic) analysis.
Author (NSA)

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N68-11948*# Raff Analytic Study Associates, Inc., Silver Spring, Md.
EXPERIMENTAL RESEARCH STUDIES ON TOOLS FOR EXTRAVEHICULAR MAINTENANCE IN SPACE, PHASE 2 Final Report
Lawrence B. Johnson and Paul W. Havener 31 Aug. 1967 71 p refs
(Contract NASw-15900)
(NASA-CR-91052; Rept.-67-9) CFSTI: $3.00 CSCL 05E

Breadboard models of two conceptual space tool designs developed in an earlier phase of this effort are evaluated. The basic concept was to develop a multipurpose power tool that would offer suit and glove protection to the space maintenance worker, a unique storage arrangement for tool attachments, and would be compatible with currently envisioned space maintenance tasks. Tool modifications and accessory development continued throughout the research program based on human, mechanical, and electrical engineering requirements, and five behavioral experiments were conducted to evaluate human performance while performing simulated maintenance tasks. Author

N68-12194# Joint Publications Research Service, Washington, D. C.
FEEDING OF ASTRONAUTS
A. Ushakov 11 Dec. 1967 6 p Transl. into ENGLISH from Med. Gazeta (Moscow), 3 Oct. 1967 p 4
(JPRS-43664) CFSTI: HC $3.00/MF $0.65

A journalistic account is given of the areas of investigations for food supply. Dehydrated foods are indicated for short space flights. For prolonged flights, food production onboard the spacecraft is discussed. The use of algae and bacteria are mentioned. Higher plants considered the most promising for a spacecraft greenhouse are potatoes, sweet potatoes, tomatoes, carrots, cabbage, and lettuce. Problems likely to be encountered with raising chickens, ducks, and rabbits are outlined. N.E.N.

N68-12218* LTV Aerospace Corp., Dallas, Tex. Astronautics Div.
THERMAL PERFORMANCE TESTS OF THE A-2H APOLLO EXTRAVEHICULAR MOBILITY UNIT, VOLUME 2
F. H. Goodnight, R. O. Pearson, and R. J. Copeland 15 Mar. 1965 836 p
(Contract NAS9-3414)
(NASA-CR-65856; Rept.-00.638, V. 2) CFSTI: $3.00 CSCL 06K

Plots are presented of Apollo space suit temperature data measured during a test series in a space environment simulator. Conducted to experimentally evaluate the thermal performance and design adequacy of the suit for extravehicular operations in space and on the lunar surface, the tests consisted of a simulated deep space extravehicular operation, lunar simulation with no tears in the suit, and lunar simulation with a vertical tear in the right leg and a v-shaped tear in the left leg. Summaries of the test conditions and thermocouple channel identifications are included. M.G.J.

N68-12309# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.
BIONICS—BASE FOR INNOVATION. A MANAGEMENT OVERVIEW OF THE BIRTH AND DEVELOPMENT OF BIONICS AT WRIGHT FIELD
K. W. Zahrt Sep. 1967 33 p
(ASB-TM-67-1; AD-660614)

The report presents the story of a new technology which has produced a flight control system with a learning, or self-organizing, functional capability; a system which can adapt more quickly than even the most skillful pilot to the flight characteristics of an aircraft. It promises a radical step forward in Air Force operational capability by, in effect, invisibly adding a superman in the cockpit to share the flight control duties. The story is a retrospective analysis which traces the evolution of a major state-of-the-art advance from the serendipity of early Air Force research planners. It illustrates the fact that a well-chosen, carefully nurtured, and well-managed, research program without a specific initial military objective often can provide a series of startling breakthroughs in weapon system operational effectiveness. The background information which introduces the story provides a realistic picture of the time factor involved in bringing hitherto unrelated research ideas into a well-focused, applicationally-oriented reality. Woven into the story are recurring references to the evolution of long range planning concepts within the Air Force research and development community. Author (TAB)

N68-12403# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
LEGIBILITY OF SEGMENTED VERSUS STANDARD NUMERALS: A REVIEW
Terrence K. Gibney Jun. 1967 12 p refs
(AMRL-TR-67-116; AD-661262)

The literature review compares the legibility of segmented numerals and standard Arabic numerals. Based on present literature, the following conclusions are drawn. When compared to standard Arabics, segmented numerals are usually found to be less legible. However, of all the nonstandard numeral designs, segmented numerals are consistently superior. As the complexity of the observers task increases, differences between the legibilities of segmented and standard numerals become insignificant. Therefore, no appreciable decrement in functional legibility is to be expected from segmented numerals in applied situations where tasks are typically complex. Practice effects, observers motivation and stress, interaction of design types, number of segments and intersegmental distance are important variables to be considered. At present, little is known about how these variables influence legibility. Future research on legibility should be conducted under conditions which most nearly simulate the situation for which the proposed design is intended. Author (TAB)

N68-12502*# Retec, Inc., Portland, Oreg.
DESIGN AND DEVELOPMENT OF A TWO-WAY BREATHING VALVE Final Report
Henry L. Burns Sep. 1968 11 p
(Contract NAS9-5598)
(NASA-CR-65730) CSCL 06B

In order to design a two-way breathing valve acceptable for space flight medical experiments, engineering activity was directed towards the improvement of available valves used with anesthesia equipment. The major area for improvement in these valves lies in the form and support of rubber flappers used as inhalation and exhalation check valves. Therefore, using only NASA-approved Apollo command module materials, an elastomer valve flapper with a heavy circular section circumferential rim was constructed. Enough hoop strength was provided with this design to eliminate the usual supporting spokes. The ability of the design to prevent flapper inversion without the aid of supporting spokes or webs was determined by an overpressurization test in which the results were plotted in terms of pressure drop in centimeters of water and back leak in liters per minute. Engineering drawings are given for the valve designed and its component parts. E.J.S.

N68-12573# Army Chemical Center, Edgewood, Md. Experimental Medicine Dept.
EFFECTS OF MAGNESIUM PEMOLINE UPON HUMAN LEARNING, MEMORY, AND PERFORMANCE TESTS, FEBRUARY–AUGUST 1966

Ronald G. Smith Oct. 1967 59 p refs
(EATR-4139; AD-661320)

The purpose of this report was to determine the effects of magnesium pemoline (a combination of 2-imino-5-phenyl-4-oxazolidinone and magnesium hydroxide) on a variety of human learning, memory, and performance tasks. magnesium pemoline (25 or 37.5 mg) or a placebo was administered orally on a double-blind basis to intelligence-matched groups of normal, adult males. These agents were administered 3 hr before the testing. Seven different tests were used in the experiment: verbal learning, motor learning, galvanic skin response, classical conditioning, visual short-term memory, auditory short-term memory, visual reaction time, and arm-hand steadiness, from the test results. It was concluded that magnesium pemoline, in the doses tested, does not facilitate learning, memory, or performance in normal, adult men. In fact, the only statistically significant effects indicate that the higher dose was deleterious for verbal and motor learning. Author (TAB)

N68-12688# California Univ., Livermore. Lawrence Radiation Lab.
PERSONNEL MONITORING WITH FILM, GLASS, AND TLD
R. L. Kathren and R. E. Yoder 7 Oct. 1966 8 p Presented at Western Ind. Health Conf., Los Angeles, 7 Oct. 1966
(Contract W-7405-ENG-48)
(UCRL-70171; CONF-661027-1) CFSTI: HC $3.00/MF $0.65

Criteria for the ideal personnel dosimeter are presented. It is concluded that no dosimeter in present use fills all the requirements. The performance of photographic film dosimeters, radiophotoluminescent glass dosimeters, and thermoluminescent dosimeters is discussed. It is concluded that radiophotoluminescent glass and thermoluminescent dosimeters are both superior to photographic film dosimeters and that the ideal personnel dosimeter should include all three radiation detectors. NSA

N68-12755# Argonne National Lab., Ill. Industrial Hygiene and Safety Div.
RADIATION SAFETY TECHNICIAN TRAINING COURSE
H. J. Moe, S. R. Lasuk, and M. C. Schumacher Sep. 1966 359 p refs Supersedes ANL-6991
(Contract W-31-109-ENG-38)
(ANL-7291; ANL-6991) CFSTI: HC $3.00/MF $0.65

Lectures prepared for a training course for radiation safety technicians are presented. Topics discussed include basic information on radiation, natural radioactivity, properties of radiations, radiation units and dose determinations, shielding, biological effects of radiation, background radiation, radiation protection standards, internal dose calculations, radiation detection principles, operating characteristics of radiation detectors, radiation survey instruments, personnel monitoring devices, air sampling methods, and the design characteristics and radiation protection problems of reactors, hot cells, and particle accelerators. NSA

N68-12798# Advisory Group for Aerospace Research and Development, Paris (France).
ASSESSMENT OF SKILL AND PERFORMANCE IN FLYING
Sep. 1966 134 p refs Presented at 23d Ann. Meeting of AGARD Aerospace Med. Panel, Toronto, 7 Sep. 1966
(AGARD-CP-14; AD-661165)

Contents: Human error research and analysis program; The analysis of human performance within the operational flight environment; Sustained pilot performance requires more than skill; Sleep rhythms in transatlantic civil flying; Navigation of helicopters in slow and very low flight: a comparison of solo and dual pilot performance; Development of the spatial orientation trainer; Measurement of performance in F-86K simulator; Measuring the pilots contribution in the aircraft control loop; Prior learning and age in relation to pilot performance; Plasma phospholipid composition as a biochemical index to stress; The electroencephalogram as a physiological criterion of performance; The use of psycho-physiological measures in the assessment of operator effort; Influence of mild hypoxia on visual perception during post-rotatory nystagmus. TAB

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N68-11906 Argentina. Comision Nacional de Energia Atomica, Buenos Aires.
MASS SPECTRA OF FURFURAL BY ELECTRIC IMPACT MECHANISMS OF IONIZATION AND DISSOCIATION [ESPECTRO DE MASAS DEL FURFURAL POR IMPACTO ELECTRONICO MECANISMOS DE IONIZACION Y DISOCIATION]
Ruben F. Cretella and Clemente J. Noutary 1967 21 p refs In SPANISH
(CNEA-196)

The mass spectrum of furfural was determined and its mono-isotopic spectrum was calculated. Correlating them with known compositions as well as with theoretical considerations and empirical rules, the ionization mechanism of average particles was postulated and the value computed was 95% of total ionization. The more important mechanisms are confirmed by the presence of metastable ions, which show the important place of the ion with mass 67 for determining its rare abundance. In this manner, the use of spectra obtained under selective conditions (rather than tabulated data) is advantageous for the study of dissociation mechanisms. The ionization potential was determined for the molecular ion, and the appearance and disappearance of the particles with mass 95. The corresponding heat of formation was calculated from the mass as well as the dissociation energy entailed by the process. Transl. by T.Z.D.

N68-11907 Technische Hochschule Munchen (West Germany).
CHARACTERIZATION OF THE ENAMINES OF PHENALENE, THEIR TRANSFORMATION INTO PYRENES, AND A NEW QUASI-AROMATIC SYSTEM [DARSTELLUNG VON ENAMINEN DES PHENALENS, DEREN UMWANDLUNG IN PYRENE UND EIN NEUES QUASIAROMATISCHES SYSTEM]
Richard Kirchlechner (Ph.D. Thesis) [1967] 85 p refs In GERMAN
CFSTI: $3.00

From phenalene, a tricyclic C–H acid hydrocarbon, the phenalenyl anion was derived; when subjected to the effect of azacyanine cations, the deep-stained, resonance-stable amino derivatives are formed from the vinylogenes of the unknown 1-methylene phenalene. The electron spectra of these new enamines were examined. High-temperature reactions resulting in closed rings and pyrenes were obtained with the N-disubstituted amino propenylide phenalenes even when substituted in the side chain. The effect of 6-dimethylamino-2-dimethylimoniomethyl fulvene perchlorate on the phenalene anion leads via a violet enamine to the azuleno[5,6,7-cd]phenalenes, a new quasi-aromatic system. Transl. by K.W.

N68-11908# Technische Hochschule Munchen (West Germany).
ON THE APPLICATION OF SHORT-INTERVAL PHOTOGRAPHY FOR EXAMINING THE ANODE EFFECT IN FUSED CHLORIDES [UEBER DIE ANWENDUNG DER KURZZEITPHOTOGRAPHIE BEI DER UNTERSUCHUNG DES ANODENEFFEKTES IN GESCHMOLZENEN CHLORIDEN]
Ingo Gessler (Ph.D. Thesis) [1967] 106 p refs In GERMAN
CFSTI: HC$3.00/MF$0.65

High speed photography of anode effects during electrolysis of molten halogens registered developing synchronized current and voltage values. Evaluation of black-white as well as colored photographs showed a three step buildup for the developing gaseous film. The formation of small gas bubbles, the development of oscillations with subsequent bubble decay, and the formation of a slick film on electrodes were already observed before reaction delay registration. Quantum mechanical calculations on anode effects established increased bonding between chlorine and carbon under the influence of an electric field as the favorable factor in total surface voltage developments. Transl. by G.G.

N68-11909 Technische Hochschule Munchen (West Germany).
EXPERIMENTAL PREPARATION OF COMPLEX ANIONS WITH TRIFLUORMETHYL LIGANDS [VERSUCHE ZUR DARSTELLUNG KOMPLEXER ANIONEN MIT TRIFLUORMETHYL-LIGANDEN]
Dieter Boerner (Ph.D. Thesis) 17 Jul. 1967 78 p refs
CFSTI: $3.00

Reaction kinetics of Lewis acids in liquid trifluoromethane were used for complex anion synthesis. The decomposition of phosphorpentafluoride at −110°C increased specific solution conductivity up to $10^{-7}/10^{-6}$ S/cm. The reaction with trimethylamine increased conductivity up to 10^{-4} S/cm; borane trifluoride in liquid CF_3H reacted similarly. Spectrographic and analytical analyses showed that CF_3-containing compounds were not formed and a dissociation reaction of $CF_3H \rightleftarrows CF_3^- + H^+$ with an intermediate stable CF_3^- anion was rejected in favor of the interim formation of difluoro carbon. A CF_3 transfer onto PF_3 in anionic compounds with CF_3 ligands was obtained by reacting $(CH_3)_3SnCF_3$ with phosphorpentafluoride. Transl. by G.G.

N68-11938*# Avco Corp., Wilmington, Mass. Avco Space Systems Div.
RESEARCH IN THE SYNTHESIS AND CHARACTERIZATION OF MAGNETIC FLUIDS, PHASE 2 Quarterly Report, Jun.–Sep. 1967
R. Kaiser Sep. 1967 33 p refs
(Contract NASw-1581)
(NASA-CR-91060; AVSSD-0341-67-CR; QR-1) CFSTI: HC $3.00/MF$0.65 CSCL 07C

Ferrofluids are prepared by dispersing a magnetic powder in a liquid in the presence of a stabilizing agent. A grinding program was initiated that incorporates the following goals: (1) study of formation of ferrofluids in organic nonpolar media, (2) preparation of ferrofluids in other media such as water, (3) preparation of ferrofluids of higher magnetic saturation and susceptibility, (4) preparation of thermally stable ferrofluids, and (5) process improvements studies. A water base fluid has been prepared for the first time. Geometric requirements for a colloidal dispersion with a high volume concentration of magnetic solids are discussed. These indicate that magnetite fluids of higher magnetic strength than have been attained to date (1000 gauss) are feasible. Author

N68-11981# Argonne National Lab., Ill.
KINETIC STUDY OF THE FLUORINATION BY FLUORINE OF SOME URANIUM AND PLUTONIUM COMPOUNDS [ETUDE CINETIQUE DE LA FLUORATION PAR LE FLUOR DE QUELQUES COMPOSES DE L'URANIUM ET DU PLUTONIUM]
Gerard Vandenbussche (Ph.D. Thesis) Aug. 1967 140 p refs
Transl. into ENGLISH from French Report CEA-R-2859
(ANL-TRANS-515; CEA-R-2859) CFSTI: HC$3.00/MF$0.65

The fluorination reactions of uranium and plutonium compounds with elementary fluorine were studied using a thermogravimetric method. These reactions are heterogeneous ones, and of the following type: $S_{solid} + G_{1\ gas} \rightarrow G_{2\ gas}$. The kinetics of these reactions correspond to a uniform attack of the entire surface of the sample. If α is the degree of completion of the reaction, k_{rel}, the relative rate of penetration of the reaction interface, and t, the time, the relation, $(1-\alpha)^{1/3} = 1 - k_{rel}\ t$ is evaluated. The mechanism of the reaction varies according to the nature of the compound. With uranium tetrafluoride, the reaction proceeds in a single step. With uranium oxides, the reaction proceeds in two steps with uranium oxyfluoride as the intermediate compound. With plutonium oxide, the reaction proceeds in two steps with plutonium tetrafluoride as the intermediate compound. With uranium trichloride, the mechanism is complex. Chlorine trifluoride is formed. Author (NSA)

N68-11990# Argonne National Lab., Ill.
NEW CONTRIBUTIONS TO THE SPECTROGRAPHIC DETERMINATION OF IMPURITIES IN URANIUM BY THE METHOD OF FRACTIONAL CARRIER DISTILLATION [NEUVAS APORTACIONES A LA DETERMINACION ESPECTROGRAFICA DE IMPUREZAS EN MATERIALES DE URANIO POR EL METODO DE DESTILACION FRACCIONADA CON PORTADOR]
C. Capdevila Aug. 1967 26 p refs Transl. into ENGLISH from Ann. Real Soc. Espan. Fis. Quim. (Madrid), Ser. B, v. 63, no. 1, 1967 p 155–168
(ANL-TRANS-514) CFSTI: HC$3.00/MF$0.65

The carrier-distillation method for determination of impurities in uranium was modified in order to get a greater sensitivity. Electrodes 9.5 mm in dia with a crater 7 mm in dia and 10 mm deep were used. The elements considered were: Al, As, B, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, P, Pb, Si, Sn, Ti, and V, over the range from 0.01 to 30 ppM. Among the different carriers tested, AgCl and the mixtures (3:1) AgCl–AgF and (4:3) AgCl–Ga_2O_3 were chosen. The following experimental variables were studied: the concentration of carriers, the arc current, the size of the vent-forming tool, and the volatilization rates of every element. Palladium, indium, and silver were tested as internal standards. A standard deviation from ±9.5 to 18.5% is reported. Author (NSA)

N68-12047# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
STABILITY OF FISSIBLE-FERTILE OXIDE SOLID SOLUTIONS IN AIR
K. D. Reeve Oct. 1966 12 p refs
(AAEC/TM-352)

The stability of $(UTh)O_2$, $(PuTh)O_2$, and $(PuUTh)O_2$ solid solutions when heated to high temperatures in air is reviewed and discussed. $(PuTh)O_2$ is chemically stable under these conditions, but compositions containing U oxidize to give either a non-stoichiometric fluorite phase containing excess O, or to this phase plus orthorhombic U_3O_8. U_3O_8 formation is to be avoided if maximum dimensional stability is required. $(UTh)O_2$ compositions containing 50 mole % or more of ThO_2 do not form an orthorhombic phase under any conditions of oxidation. Information on the extent of nonstoichiometry and the effects of excess oxygen on unit cell volume, bulk volume, and the rate of uranium loss at high temperatures is also reviewed. Author (NSA)

N68-12074# Little (Arthur D.), Inc., Cambridge, Mass.
THE ELECTRICAL CONDUCTIVITY OF AQUEOUS TETRAALKYLAMMONIUM HALIDE SOLUTIONS UNDER HYDROSTATIC PRESSURE

R. A. Horne and R. P. Young 10 Nov. 1967 28 p refs
(Contract Nonr-4424(00))
(TR-31; AD-661218)

The electrical conductivities of 0.10M aqueous solutions of the salts R4N(+)A(-) where R is CH3, C2H5, C3H7, n-C4H9, and n-C5H11 and A(-) is Cl(-), Br(-), and I(-) were measured at 4C and 25C over the pressure range 1 atm to 4,000 kg/sq cm. The results of these measurements support the viewpoints that (1) the hydrophobic hydration atmospheres of these ions are fundamentally different from the coulombic hydration envelopes surrounding normal ions such as the alkali metal cations, in particular being much more stable with respect to hydrostatic pressure, and (2) cation-cation interactions are important in solutions of the larger ions in this series. Author (TAB)

N68-12140# Los Alamos Scientific Corp., N. Mex.
PROCESSING OF PLUTONIUM BY ION EXCHANGE. 8: SELF-DIFFUSION STUDIES IN ANION-EXCHANGE RESIN
D. B. James and W. A. Beyer 14 Sep. 1966 10 p refs
(Contract W-7405-ENG-36)
(LA-3534) CFSTI: HC $3.00/MF $0.65

The isotopic migration rate of plutonium(IV) in Dowex 1 anion-exchange resin was studied for varying temperature, nominal percent cross-linking, and fractional equilibrium loading with plutonium. The diffusion coefficient decreased very rapidly with increasing loading. A diffusional model suggested by these results is qualitatively discussed. Author (NSA)

N68-12141# Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Institut fuer Chemie.
DETERMINATION OF IMPURITIES IN RED PHOSPHORUS BY MEANS OF NEUTRON ACTIVATION AND GAMMA SPECTROSCOPY [BESTIMMUNG VON VERUNRE INIGUNGEN IN ROTEM PHOSPHOR DURCH NEUTRONENAKTIVIERUNG UND GAMMASPEKTROMETRIE]
P. Patek and H. Sorantin 1966 15 p refs In GERMAN; ENGLISH summary Submitted for Publication
(SGAE-CH-31/1966)

In six samples of red phosphorus of different origin trace elements were determined by non-destructive neutron activation analysis. Only those nuclides were determined, which have a half-life shorter than 15 hr. Qualitatively 7 elements were detected, some of them were analysed quantitatively, comparing their activity with simultaneous irradiated standards. Large differences in the amount of trace elements in the different phosphorus samples were observed. Sodium and aluminum were the most important contributors to the impurity level. Author (NSA)

N68-12143 Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).
DETERMINATION OF HEATS OF OXIDATION OF URANIUM SULPHIDES
D. Kolar, M. Komac, M. Drofenik, M. Bohinc, V. Marinkovic et al Aug. 1967 13 p refs
(NIJS-R-508) CFSTI: $3.00

Oxidation of US and US_2 was investigated and heat effects were evaluated using quantitative differential thermal analysis. Oxidation was observed in a DTA apparatus in static air and flowing oxygen. The heating rate was 5 or 10°C/min. Oxidation of sulphides was also studied using X-ray photographs of specimens previously heated for one hour at atmospheric pressure at temperatures of 100, 200, 300, 400, 500, and 600°C. Results show that oxidation of uranium sulfides began above 225°C. The main reaction, oxidation to UO_2, ended below 400°C. At this temperature some U_3O_8 was already present. At 500° the only product present was U_3O_8. Values for heats of oxidation of US and US_2 to U_3O_8 were: −276±12 kcal/mol for US at 370°C and −345±24 kcal/mol for US_2 at 358°C. E.C.

N68-12154 Joint Publications Research Service, Washington, D. C.
ORGANOPHOSPHORUS SUBSTANCES
M. I. Kabachnik 13 Dec. 1967 42 p Transl. of the book "Fosfororganicheskiye Veshchestva" Moscow, Znaniye, 1967 p 1-32
(JPRS-43702) CFSTI: $3.00

The foundations of organophosphorus chemistry and recent developments in the synthesis and applications of the compounds are reviewed. Organophosphorus compounds used for the protection of plants and in medicine are discussed. The formation of organophosphorus complexons in metals and the use of organophosphorus additives in lubrication oils are described, and the application of noncombustible organophosphorus fluids for aircraft hydraulic systems is indicated. It is pointed out that the polymers have uses as ion exchange resins and for making nonflammable textiles. The action of these substances in alcohol fermentation, and in the conversion of chemical energy to mechanical energy and metabolic processes in animals is also described. N.E.N.

N68-12163# Argonne National Lab., Ill.
LABORATORY INVESTIGATIONS IN SUPPORT OF FLUID-BED FLUORIDE VOLATILITY PROCESSES. PART 14: THE CORROSION OF NICKEL AND NICKEL ALLOYS BY FLUORINE, URANIUM HEXAFLUORIDE, AND SELECTED VOLATILE FISSION PRODUCT FLUORIDES AT 500°C
William H. Gunther and Martin J. Steindler Dec. 1966 40 p refs
(Contract W-31-109-ENG-38)
(ANL-7241) CFSTI: HC $3.00/MF $0.65

The corrosion of selected materials of construction by fluorides of interest in the Fluoride Volatility Process has been studied. The metals investigated include: Ni-200, Ni-201, Monel, Inconel, Dura-nickel-301, HyMu-80, INOR-8, and Ni-200 coupons containing areas of Ni-200 weld, Ni-61 weld, or silver solder. Exposures of these metals for periods up to 30 hr at 500°C were carried out in elemental F_2, UF_6, SF_6, and some of the following volatile fission product fluorides, both individually and in the presence of F_2: GeF_4, AsF_5, NbF_5, SbF_5, BrF_5, SeF_6, MoF_6, and TeF_6. Corrosion rates were calculated from both the weight gain of the coupons after exposure and the weight loss of the coupons after descaling in a KNO_3–$NaNO_3$ bath at 500°C. All of the exposed coupons were examined microscopically for intergranular penetration of the base metal. Nickel-200 and Monel exhibited the best overall resistance to corrosion by F_2, UF_6, and some of the volatile fission product fluorides individually and in the presence of F_2 at 500°C. Author (NSA)

N68-12166# Iowa State Univ. of Science and Technology, Ames.
SOME ANALYTICAL APPLICATIONS OF ESTERS OF PHOSPHOROTHIOIC AND PHOSPHORODITHIOIC ACIDS
Martha Ann Sudholt Schmitt (M.S. Thesis) Feb. 1967 41 p refs
(Contract W-7405-ENG-82)
(IS-T-144) CFSTI: HC $3.00/MF $0.65

Sodium diisooctyl and diheptylphenyl phosphorodithioate and di-n-butyl phosphorothioic acid were studied as the immobile phases in ascending reversed-phase partition paper chromatography. R_f values were recorded for twenty-nine cations. Distribution ratios for thorium(IV), zirconium(IV), lanthanum(III), erbium(III), and calcium(II) with di-n-butyl phosphorothioic acid in hydrochloric acid–carbon tetrachloride systems were investigated. The quantitative separations of thorium(IV) and erbium(III) and calcium(II) and erbium(III) by liquid–liquid extraction were achieved. Author (NSA)

N68-12211# Michigan State Univ., East Lansing. Dept. of Chemistry.
PREPARATION, CHARACTERIZATION, AND SOME THERMODYNAMIC PROPERTIES OF LANTHANUM–OXIDE-CARBIDE, $La_2O_2C_2$
Duane A. Butherus and Harry A. Eicc Mar. 1967 10 p refs Presented at the 6th Rare Earth Res. Conf., Gatlinburg, Tenn.
(Contract AT(11-1)-716)
(COO-716-027; Conf-670502-3) CFSTI: HC $3.00/MF $0.65

A lanthanum-oxide-carbide of the general formula $La_2O_2C_2$ has been prepared by the reaction of molten lanthanum metal with carbon monoxide, by the reaction of lanthanum metal with the sesquioxide and carbon, by the reaction of lanthanum dicarbide with the sesquioxide and carbon, and by the reaction of sesquioxide with graphite. A carbon monoxide equilibration study undertaken on the reaction, $La_2O_3(s) + 3C(s) = La_2O_2C_2(s) + CO(g)$ in a closed constant volume system produced the following data: $\Delta H^0_{298} = 82.16 \pm 2.0$ kcal/mole, and $\Delta S^0_{298} = 36.67 \pm 3.5$ eu. By combining these values with the appropriate thermodynamic data, a heat of formation of -313.6 ± 3.0 kcal/mole is calculated for this phase. A third heat law calculated with tabulated free energy functions for the sesquioxide, graphite, and carbon monoxide, and estimated for the oxide–carbide species is in agreement with the values cited above. Author (NSA)

N68-12214# Union Carbide Nuclear Co., Oak Ridge, Tenn. Gaseous Diffusion Plant.
LIQUID CONDENSATION OF A URANIUM HEXAFLUORIDE-BROMINE PENTAFLUORIDE MIXTURE FROM A NONCONDENSABLE CARRIER GAS STREAM
D. I. Dunthorn 1 Feb. 1967 52 p refs
(Contract W-7405-ENG-26)
(K-L-2223) CFSTI: HC $3.00/MF $0.65

Two basic designs for a liquid condenser are considered: the flash cooler, in which all condensation heat is removed by precooling the liquid bromine pentafluoride to be added, and the cooled condenser, in which condensation heat is removed partially by flash cooling with the added bromine pentafluoride and partially by gas heat exchange within the condenser. Although these two designs are essentially extensions of one another, they are often treated separately because they require somewhat different design analyses. Design calculations were done using programs for an IBM-7090. Detailed descriptions, along with listings of the computer programs, are appended. NSA

N68-12225# Reed College, Portland, Oreg.
REACTION RATE STUDIES OF GASEOUS UNIMOLECULAR ISOMERIZATIONS Final Report, Oct. 1962–31 Aug. 1967
Frederick D. Tabbutt 12 Oct. 1967 26 p refs
(Grants AF-AFOSR-119-63; AF-AFOSR-119-65)
(AFOSR-67-2449; AD-660591)

The project sought evidence for biradical intermediates in the classical unimolecular, thermal, isomerizations of cyclopropane and cyclobutane. Based on the hypothesis that the intermediates do exist but are too short-lived to have been detected previously, a technique was developed to allow these reactions to be studied quantitatively up to pressures of 300 atmospheres. It was hoped that at high enough pressures the intermediate could be engaged in a collision resulting in either a reaction or a deactivation, either one of which might produce a new product. The cyclopropane system showed no evidence of any intermediate which was longer lived than 10 to the -13 power seconds and reactive or deactivated. Linear first order plots are obtainable which yield rate constants in agreement with those calculated from the data of previous workers at low pressure. This would indicate that the decomposition of cyclobutane is not affected seriously by the other reactions. This would favor the tetramethylene mechanism although it is not conclusive. The existence of tetramethylene is neither proven nor disproven. Author (TAB)

N68-12228# Aerospace Corp., El Segundo, Calif.
TEMPERATURE DEPENDENCE OF CHEMILUMINESCENT REACTIONS. VOLUME 1: THE NITROGEN AFTERGLOW
Rolf W. F. Gross Jun. 1967 25 p refs
(Contract AF 04(695)-1001)
(TR-1001(2240-20)-6, V. 1; SSD-TR-67-157, V. 1; AD-661255)

Using the recently developed glow discharge shock tube, measurement was made of the temperature and density dependence of the Lewis-Rayleigh afterglow between 300 and 2400K. The absolute efficiency, i.e., the rate constant of this chemiluminescent reaction, was also determined. TAB

N68-12246# Union Carbide Nuclear Co., Oak Ridge, Tenn. Gaseous Diffusion Plant.
ANALYTICAL PROCEDURES FOR URANIUM SPECIFICATIONS
J. C. Barton, C. W. Weber, L. A. Smith, and W. D. Hedge, ed. 6 Apr. 1967 190 p refs
(Contract W-7405-ENG-26)
(K-L-6140) CFSTI: HC $3.00/MF $0.65

Analytical procedures used for the systematic specification analysis of various uranium compounds which are returned to the USAEC through the Oak Ridge Gaseous Diffusion Plant are compiled. The compounds normally encountered are UF_6, UF_4, UO_2, UO_3, U_3O_8, and $UO_2(NO_3)_2$. Accepted laboratory practices and standard equipment operations are omitted for brevity. The method for listing procedures is described, and an index for location of particular operation or specification analysis is included. NSA

N68-12255# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
PREPARATION OF ISOTOPICALLY PURE PLUTONIUM-241 METAL
W. V. Conner 8 Sep. 1967 8 p refs
(Contract AT(29-1)-1106)
(RFP-1007) CFSTI: HC $3.00/MF $0.65

Procedures are described for the production of two batches of isotopically pure ^{241}Pu metal from PuO_2, and for the recovery of Pu from reduction residues. The conversion of the oxide to PuF_4 was accomplished with F_2. The PuF_4 was reduced to metal using Ca as the reductant, with an I_2 booster. The Pu recovery was performed by HNO_3 dissolution, anion exchange, and oxalate precipitation. Author (NSA)

N68-12277 Technische Hochschule Munchen (West Germany).
PARTICIPATION OF ADJACENT GROUPS IN THE STEREOSPECIFIC SYNTHESIS OF CYCLOPENTANE AMINOPOLYOLES [DIE ROLLE DER NACHBARGRUPPEN-BETEILIGUNG BEI DER STEREOSPEZIFISCHEN SYNTHESE VON CYCLOPENTANAMINOPOLYOLEN]
Roland Rubner (Ph.D. Thesis) [1967] 82 p refs In GERMAN
CFSTI: $3.00

Quantitative gas chromatographic analyses of reaction products from bromide substituted cyclopentane aminopolyolenes and derivatives in different acetate solutions found a trans-configuration product in dehydrogenated acetic acid, and a cis-diolderivate inversion in watery acetic acid reaction media. Nuclear magnetic resonance spectra of polysubstituted cyclopentane and cyclopentane model compounds after acetylation established an envelope conformation attributed to the participation of neighboring acetic oxide groups. Transl. by G.G.

N68-12316*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
POLYMER RESEARCH
In its Space Programs Sum. No. 37-47, Vol. 3 31 Oct. 1967 p 85–101 refs (See N68-12306 03-30)

Polymer research is reported in the areas of (1) aliphatic ionene synthesis and characterization, (2) speculations on the involvement of strain rate in the deformation of elastomers, (3) the mechanism of polymerization and structure of nitroso rubber, (4) the presence of crystallinity in hydrogenated polybutadienes, and (5) the suitability of thermoplastic rubbers as binders for composite solid propellants. C.T.C.

N68-12330# California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology.

SOLUBILIZATION METHOD FOR CENTI-GRAM TO KILO-GRAM PLANT SAMPLES

R. A. Wood, S. T. Wakakuwa, and T. H. Rutherford Jan. 1967 11 p refs

(Contract AT(04-1)-GEN-12)

(UCLA-12-613) CFSTI: HC$3.00/MF$0.65

A method is described for the solubilization of 100 to 1000 gram plant samples prior to the sequential separation and quantitative determination of ^{90}Sr, ^{144}Ce, ^{144}Pr, ^{137}Cs, and the stable elements Sr, Ca, P, K, and Ba. Radioexchange and solubilization are initiated by refluxing the partially oxidized (dry-ashed) sample with concentrated nitric acid followed by neutralization, and the dropwise addition of 30% hydrogen peroxide. After the solution becomes light amber to yellow in color, any residue present is collected by filtration and separately solubilized residue is recombined with the original sample, the hydrogen peroxide treatment is continued at a pH 5 to 6 for 2 hr or until the sample becomes aqueous clear. Using this method the solubilization time was reduced from a minimum of 7 to 2 days. Author (NSA)

N68-12341# Iowa State Univ. of Science and Technology, Ames.

INVESTIGATIONS OF SOME METHODS FOR PREPARING THORIUM CHLORIDE

Roger Michael Bergman (M.S. Thesis) Feb. 1967 122 p refs

(Contract W-7405-ENG-82)

(IS-T-150) CFSTI: HC$3.00/MF$0.65

Several approaches toward $ThCl_4$ preparation were investigated and the results are reported. In exploratory investigations, a variety of thorium source materials and chlorinating agents were studied. Considering the relative reactivities of thorium compounds toward chlorination, it was found that the oxalate was the most readily chlorinated of those compounds that were investigated. Low-fired oxide was next in order and the nitrate, sulfate, and high-fired oxide were found to be very difficult to chlorinate under the conditions employed. Chlorinating agents investigated included: chlorine alone; systems based on carbon tetrachloride, i.e., CO_2+CCl_4, Cl_2+CCl_4, and $He+CCl_4$; chlorine plus sulfur chlorides; and variations of a carbon plus chlorine approach. On the basis of the results of the preliminary investigations, the chlorination of thorium oxalate with mixtures of CO_2 and CCl_4 was selected for a more detailed study. In the present state of development, a charge of thorium oxalate is chlorinated in a fixed bed type reactor with approximately 1:1 mole mixtures of CO_2 and CCl_4. The reaction temperature is raised from 300 to 610°C in the course of the reaction which takes from 5 to 6 hours. Analytical data indicate that the product is approximately 99.4% tetrachloride (less than 0.08% oxygen). Batches as large as 3/4 pound have been prepared by this technique. In order to further evaluate the quality of the tetrachloride and to demonstrate that this chloride is of acceptable quality for metal preparation, magnesium reductions were made. The thorium obtained from these reductions was arc melted to yield good quality metal. Analytical results indicated oxygen contamination of about 925 ppM, carbon 27 ppM, and only about 3 ppM nitrogen. The Vickers hardness number of this thorium was about 38 to 44 as arc melted and 33 to 36 after annealing. This quality of metal is equivalent to that obtained from chloride prepared by other methods involving one or more intermediate purification steps. Therefore, it appears that the direct preparation of thorium tetrachloride by this CO_2–CCl_4 process has significant advantages over other processes that have been employed for preparing the tetrachloride. (60 references.) NSA

N68-12410 India. Dept. of Atomic Energy, Bombay.

ISOTOPIC ANALYSIS BY INFRARED SPECTRA IN THE SOLID STATE

C. R. Subramaniam and Santha S. Kartha 1967 12 p refs

(B.A.R.C.-281)

Advantages of solid state infrared spectral studies for isotopic analysis are described and the method is compared to the usual liquid or vapour phase spectral studies. A convenient low-temperature cell for obtaining the spectra down to liquid nitrogen temperatures is described. The application of the method to several isotopic species like mixtures of H_2O and D_2O, ammonia and deutero ammonia, borazine and B-deutero borazine, etc. is discussed. Author

N68-12411# Picatinny Arsenal, Dover, N. J. Explosives Lab.

NEUTRON DIFFRACTION STUDY OF ALPHA-LEAD AZIDE

Chang S. Choi and Henri P. Boutin Oct. 1967 17 p refs

(PA-TR-3572; AD-661039)

The structure of alpha-lead azide was investigated by using three-dimensional neutron diffraction. The atomic positions were refined in the centrosymmetric space group, PcMn, and anisotropic temperature factors were obtained for each atom. The interatomic distances are determined with average standard deviations less than 0.01 A. It was found that there are four different types of azide structures in a unit cell. The azide groups are all linear but differ considerably in degree of symmetry and also in bonding to the neighboring atoms. Author (TAB)

N68-12418# Oak Ridge National Lab., Tenn. Nuclear Div.

SPECTROCHEMICAL DETERMINATION OF IMPURITIES IN TUNGSTEN

R. B. Farrar, D. C. S. Randolph, and H. H. Sullivan 5 Jul. 1967 41 p refs

(Contract W-7405-ENG-26)

(K-1683)

Twelve spectrochemical procedures were developed for the determination of impurities in tungsten. These procedures include a direct burn method for calcium, eight carrier distillation procedures for common metals, the cupferron group separation, the platinum group separation by zinc reduction and separation of the rare earth elements using an ammonia precipitation. Sixty-one elements are measurable; fifty-six of the elements are determinable in the range of 0.1 to 3 ppM. Author (NSA)

N68-12438# Picatinny Arsenal, Dover, N. J. Feltman Research Labs.

CHANGE IN CHEMICAL POTENTIALS AND PARTIAL PRESSURES OF THE COMPONENTS OF TERNARY TWO-PHASE SYSTEMS WITH ISOTHERMAL-ISOBARIC CHANGE IN COMPOSITION. 1

A. V. Storonkin and M. M. Shul'ts Oct. 1967 21 p refs Transl. into ENGLISH from Vestn. Leningr. Univ. (Leningrad), v. 11, 1954 p 153–165

(PA-TT-67; AD-661038

The general conditions relating the variations in the composition and chemical potentials of ternary two-phase systems under constant pressure and temperature are derived. The conditions of passage through extrema of chemical potentials and partial pressures of the components of ternary systems during isothermal–isobaric

variation in the composition of these systems are determined. The rules for determining the orientation of the changes in partial pressures and chemical potentials of components during isothermal and isotherm–isobaric variation in the composition of ternary saturated solutions are formulated. Author (TAB)

N68-12441# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.

THE DIRECT SYNTHESIS OF ORGANOGERMANIUM TRIHALIDES

E. Vassiliou and E. G. Rochow Sep. 1967 28 p refs
(Contract ARPA SD-88)
(ARPA-32; AD-661202)

N-alkyl chlorides above propyl chloride react with germanium in the presence of copper as catalyst at 375–425°C to yield n- and i-alkylgermanium trihalides. The by-products of this reaction are the corresponding n- and i-alkenes. Chlorocyclohexane shows a rather poor yield. Phenyl germanium trichloride can be prepared by the action of germanium tetrachloride and phenyl chloride on germanium under similar conditions. Author (TAB)

N68-12467# European Atomic Energy Community, Ispra (Italy).

RELEASE OF KRYPTON CONTAINED IN A THIN LAYER OF URANIUM CARBIDE [DEGAGEMENT DU KRYPTON CONTENU DANS UNE COUCHE MINCE DE MONOCARBURE D'URANIUM]

A. Schuerenkaemper and O. Gautsch Sep. 1967 21 p refs In FRENCH
(EUR-3556.F) CFSTI: HC$3.00/MF$0.65

UC powders of different particle sizes were irradiated with thermal neutrons in presence of a few atmospheres of $Kr+Kr^{85}$. After irradiation about 10^{13} atoms of Kr were found per cm^2 of the UC surface and per atmosphere of Kr-pressure at room temperature. During thermal annealing large fractions of the gas were released below 430°C. Between 430°C and 1000°C the release rate seemed independent of the temperature. Above 1000°C the rates of emission increased again. From the release curves activation energies of 10–20 Kcal/mole could be deduced for the low temperatures, and 62–85 Kcal/mole for temperatures above 1000°C. Author

N68-12471# Wein Univ. (Austria). Inst. for Experimental Physics.

TUNGSTEN COMPOUNDS AS LIQUID ABSORBERS FOR MOESSBAUER EXPERIMENTS

P. Weinzierl 30 Jul. 1967 26 p refs
(Contract AF 61(052)-845)
(SR-1; AFOSR-67-2581; AD-661283)

The recoilless fraction f sub A of Na2WO4 and of the tungsten(VI)-halides WF6, WCl6 and WO2Cl2 is measured at 77K in a Mossbauer transmission experiment using the 46.5 keV transition in 183W. The Debye temperatures of these compounds were derived and the feasibility of Mossbauer transmission experiments with tungsten(VI)-halides near the melting point as absorbers is discussed with respect to the study of diffusion. Author (TAB)

N68-12495 Commissariat a l'Energie Atomique, Saclay (France). Department des Radioelements.

PILOT PLANT FOR SEPARATION OF CAESIUM-137 BY PRECIPITATION [INSTALLATION PILOTE DE SEPARATION DU CAESIUM 137 PAR PRECIPITATION]

J. Fradin and M. Quesney Brussels Euratom 1967 239 p
(Contract Euratom-025-62-10 RISF)
(EUR-3611.f)

The pilot plant was constructed in order to test the value of the chemical separation procedure and to obtain technological information on the chemical apparatus and materials employed. Another aim was to separate a significant quantity of caesium-137 for the study and development of the fabrication of sealed sources. The report describes the chemical process, the assembly and protection of the plant, the equipment used and also the measurement, control, regulation and monitoring techniques employed. Author (NSA)

N68-12496# Oak Ridge National Lab., Tenn.

CHEMICAL SEPARATIONS IN MOLTEN FLUORIDES

F. F. Blankenship [1966] 9 p refs Presented at the 2d Intern. Thorium Fuel Cycle Symp., Gatlinburg, Tenn.
(Contract W-7405-ENG-26)
(ORNL-P-2601; CONF-660524-25) CFSTI: HC$3.00/MF$0.65

The separation of iodine from molten fluoride fuels containing LiF, BeF_2, UF_4, and possibly ZrF_4 and rare earths from Molten Salt Reactor Fuel containing LiF, BeF_2, and ZrF_4 are discussed. Iodine was removed by sparging with HF, and the rare earths were removed by distillation of the fuel constituents. NSA

N68-12507# Oak Ridge National Lab., Tenn.

LITERATURE SURVEY OF RADIOCHEMICAL CROSS-SECTION DATA BELOW 425 MEV

H. W. Bertini, M. P. Guthrie, E. H. Pickell, and B. L. Bishop Oct. 1966 55 p refs
(Contract W-7405-ENG-26)
(ORNL-3884) CFSTI: HC$3.00/MF$0.65

The results of a literature survey that was made of radiochemical cross sections below 425 MeV are given in tabular form. The cross-section data are tabulated for reactions involving incident protons, neutrons, and π mesons in the energy range from about 20 to 400 MeV interacting with nuclei ranging from lithium to the heavy-weight elements. Author (NSA)

N68-12512# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.

[STUDIES IN ORGANOPHOSPHOROUS AND ORGANOMERCURY CHEMISTRY] Final Report, 1 Oct. 1960–30 Sep. 1966

Dietmar Seyferth 30 Sep. 1966 7 p refs
(Grants DA-ORD-31-124-61-G14; DA-ORD-31-124-G207; DA-ORD-31-124-G495)
(AROD-2832-37-C; AD-659402)

A very brief review is given of work which involved (1) the reactions of organolithium reagents with quarternary phosphonium halides; (2) syntheses based on phosphine alkylidene chemistry; and (3) generation of carbenes by the thermolysis of PHHGCX3. A list of the 31 papers published as a result of the work is included. TAB

N68-12523# United Kingdom Atomic Energy Authority, Harwell (England).

THE RADIATION CHEMICAL CONVERSION OF HYDROCARBONS: THE OXIDATION OF METHANE

Horst Luther, Detlef Boenisch, and Gerd Baumgarten [1967] 31 p refs Transl. into ENGLISH from Brennstoff-Chem. (Essen), v. 47, 1966 p 375–383
(NP-TR-1579)

The oxidation of methane by γ rays from a ^{60}Co source under normal conditions in the presence of Kr as a radiation sensitizer was studied. The type of inert gas added, mixing ratio of

the reactants, period of irradiation, pressure variations, temperature variations, wall variations, and additives were examined. Products analyzed were CO, CO_2, CH_3OH, HCOOH, and $HCOOCH_3$. The intermediate oxidation step products all showed a maximum in partial pressure as a function of irradiation time; yields of CH_3OH and HCOOH decreased with increasing temperature. Maximum yields of these products were also obtained at a $Kr:CH_4:O_2$ ratio of 40:7:3. Interrelations of the yield of methanol, formic acid, and methyl formate are discussed in connection with mixing ratio experiments. NSA

N68-12554# Carnegie Inst. of Tech., Pittsburgh, Pa. Dept. of Chemistry.

NUCLEAR CHEMISTRY AND GEOCHEMISTRY RESEARCH, CARNEGIE INSTITUTE OF TECHNOLOGY, 1966–1967 Progress Report

Truman P. Kohman 30 Jun. 1967 74 p refs

(Contracts AT(30-1)-844; AT(30-1)-3624)

(NYO-844-71) CFSTI: HC$3.00/MF$0.65

Research progress is reported on: Moessbauer spectroscopy of Fe in coal, terrestrial occurrence and distribution of ^{129}I, μ^--induced nuclear reactions in natural materials, activation analysis of iron meteorites, isotopic composition of thallium in meteorites, plans for radiogenic isotope studies of lunar materials, expectation levels of ^{129}I in meteorites, search for radioactivity of ^{48}Ca, counting systems, and cylindrical anticoincidence guard counter. NSA

N68-12564 Novosibirsk State Univ. (USSR). Thermal Physics Inst.

THE RELATION OF EFFECTS OF DYNAMIC AND STATIC PRESSURES ON THE EXAMPLE OF OXIDES OF THE 4th GROUP ELEMENTS

V. A. Kirkinsky 1967 6 p refs Presented at the Symp. on High Dyn. Pressure, Paris, 11–15 Sep. 1967

The effects of shock waves from exploding ampoules on phase transitions in germanium dioxide, silicon dioxide, titanium dioxide, tin dioxide, and lead dioxide, are reported. L.S.

N68-12586# Polish Academy of Sciences, Cracow. Inst. of Nuclear Research.

ROUTINE CHEMICAL AND RADIOCHEMICAL PURITY CONTROL OF RADIOISOTOPIC PREPARATIONS. 1: CR-51 PREPARATIONS [METODY RUTYNOWEJ KONTROLI CZYSTOSCI CHEMICZNEJ I RADIOCHEMICZNEJ PREPARATOW RADIOIZOTOPOWYCH. 1: PREPARATY CR-51]

Kazimierz Nowak and Antoni Pasternak 1967 14 p refs In POLISH

(INR-811/13/C)

Methods for routine chemical and radiochemical control of ^{51}Cr preparations, $CrCl_3$ and Na_2CrO_4, are given. For total Cr determination a colorimetric method is used. The sample is oxidized with a few drops of 1% $KMnO_4$ solution and heated on the water bath for 40 min. The $KMnO_4$ oxidizes Cr(III) to Cr(VI) and destroys H_2O_2, which is used for stabilizing Cr(VI) form in Na_2CrO_4 preparations. The excess $KMnO_4$ is destroyed by a 0.5% sodium azide solution. After adding 1 ml 0.25% solution of diphenylcarbazide in 95% ethyl alcohol the optical density of Cr(VI) diphenylcarbazide complex was measured at a wavelength of 540 nm. The Cr content was calculated by use of a calibration curve. Standard error for a single determination was about 6%. For radiochemical purity control ascending paper chromatography was used. Each section of paper was rolled up and the activity of twists subsequently measured using a well-counting NaI crystal. The quantity of impurities was calculated as percent of activity in proportion to the total activity of the strip. One standard error of determination was not higher than 5%. The accuracy of measurements was about 4.5%. Author (NSA)

N68-12574# Aeroneutronic, Newport Beach, Calif.

ABSORPTION BY H_2O BETWEEN 5045–14,485 CM^{-1} (0.69–1.98 MICRONS)

Darrell E. Burch and David A. Gryvnak 31 Jul. 1968 124 p refs

(Contract Nonr-3560(00); ARPA Order 237)

(U-3704; AD-657629)

The absorption by water vapor in six spectral regions within 5045–14,485/cm (1.98–0.69 microns) was investigated. Samples at high pressures are presented to provide data from which line strengths and band strengths can be determined, while samples at lower pressures provide information from which line widths can be found. Transmission spectra are shown along with extensive tables of transmittance, integrated absorptance, and integrated absorption coefficient. The integrated absorption coefficients in 1/cm/gm/(sq. cm.) were found to be as follows: 5045–5870/cm, 3.16 plus or minus 1600; 6640–7700/cm, 2.54 plus or minus 1300; 8560–9030/cm, 1.66 plus or minus 80; 9940–11,420/cm, 895 plus or minus 50; 11,795–12,765/cm, 57.2 plus or minus 2.7; and 11,385–14,485/cm, 56.1 plus or minus 2.8. Author (TAB)

N68-12580# Argonne National Lab., Ill.

STUDY OF THE REACTIONS ClF_3–UO_2F_2 AND ClO_2F–UO_2F_2 [ETUDE DES REACTIONS ClF_3–UO_2F_2 ET ClO_2F–UO_2F_2]

Michel Luce and Olivier Hartmanshenn Mar. 1967 23 p refs Transl. into ENGLISH from French Report CEA-R-3210

(ANL-Trans-524; CEA-R-3210) CFSTI: HC$3.00/MF$0.65

The reaction between ClF_3 and UO_2F_2 is explained in terms of two secondary reactions involving the interaction between ClF and ClO_2F on UO_2F_2. The origin of the by products is indicated (ClO_3F, ClO_2HF). Author (NSA)

N68-12585# Oak Ridge National Lab., Tenn.

EXPLOSIVE REACTION BETWEEN IRRADIATED LIQUID NITROGEN AND OXYGEN

Zenichiro Kuri, Shoji Shida, and Shiro Haruhara [1967] 7 p Transl. into ENGLISH from Proc. Japan Conf. Radioisotopes, No. 4, 1961 p 284–286

(ORNL-TR-1774)

When liquid nitrogen (LN) is irradiated by γ rays or high-energy electrons, its color changes to deep blue from the original transparent. If one drop of acrylonitrile is added onto the irradiated LN in a beaker, the acrylonitrile often explodes, in which case the glass beaker is violently broken. If ca. one cc of the irradiated LN is dropped on to liquid acrylonitrile, the drops of LN moving about on the liquid surface evaporate out and the color deepens to dark violet, until an explosive firing occurs and the liquid monomer begins to burn with the aid of the surrounding air. In both the experiments, when the vessel is being poured in an atmosphere of carbon dioxide gas, the explosive sound can be heard but the firing or burning is not seen. Various organic compounds are classified into explosive and nonexplosive groups. The lower limit of dosage for explosion is about 10^6 r, where LN begins to be colored. Temperature of the compounds influences the explosive character. Liquid oxygen behaves as same as LN and its radioinduced coloration is dark greenish purple. Concerning the explosive character, however, it is insensitive up to 10^8r. NSA

N68-12586# Norsk Radiumhospital, Oslo.

BETATRON IRRADIATION OF OXYGEN AT 31 MEV

Aksel Stroemme [1967] 7 p refs
(Contract AT(30-1)-3364)
(NYO-3364-31) CFSTI: HC$3.00/MF$0.65

Three different compounds of oxygen were irradiated with betatrons at an energy of 31 MeV: H_2O distilled, triple distilled, and tap water; pure H_3BO_3; and pure Al_2O_3. The production of four radioisotopes was noted: ^{14}O, ^{15}O, ^{13}N, and ^{11}C. The proportion of these at a dose of 200 R and an irradiation time of about 12 min and 30 sec was: 8.10^3:4.10^3:3:1. NSA

N68-12587# Los Alamos Scientific Lab., N. Mex.
VAPORIZATION OF THE ACTINIDES AND THEIR COMPOUNDS. 2: VAPORIZATION OF SOME THORIUM COMPOUNDS
I. Krivy Feb. 1967 25 p refs Transl. into ENGLISH from Czechoslovakian Rept. UJV-1738
(LA-TR-67-51; UJV-1738) CFSTI: HC$3.00/MF$0.65

The vaporization of some binary compounds of thorium, namely oxides, carbides, silicides, germanides, nitrides, phosphides, and sulfides is discussed. A survey and evaluation was made of all the available papers in the field up to the end of the past year, particular attention being paid to the compounds of interest in nuclear reactor technology, such as ThO_2 and ThC_2. For each two-component system (e.g., oxides, carbides etc.) a list of the binary compounds and their crystal structures is given, along with the composition of the vapor over the condensed phases (at least qualitatively) together with the dependence on the experimental conditions, and last, the results of tensimetric experiments usually given in the form $\log P = \phi(T)$. The values of dissociation energy for the gaseous species or eventually those of standard free energy of formation for the individual condensed phases (ΔG^0_f) are presented provided that they are derived on the basis of tensimetric data. (27 references). Author (NSA)

N68-12596# Los Alamos Scientific Lab., N. Mex.
BEHAVIOR OF LONG-LIVED FISSION PRODUCTS IN SODIUM
J. C. Clifford 1 Jun. 1967 9 p
(Contract W-7405-ENG-36)
(LA-3737) CFSTI: HC$3.00/MF$0.65

Long-lived fission products have been introduced into a small, forced convection Na loop by immersing a trace-irradiated Pu alloy in the flowing Na. The distribution of Pu, ^{90}Sr, ^{137}Cs, and ^{155}Eu in the loop, over periods of 1000 to 3000 hr, has been observed by in situ gamma scanning of loop components and by radiochemical analysis of traps and metal specimens removed from the loop. Hot trapping, cold trapping, and graphite adsorber experiments have been conducted. Author (NSA)

N68-12602# Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
REPROCESSING OF IRRADIATED FUELS Annual Report, Jul. 1965–Jun. 1966
Brussels EURATOM Jun. 1966 40 p
(Contracts EURATOM-006-65-7 RAP-B; EURATOM-016-65-1 RAP-B)
(EURAEC-1909; EUR-3394) CFSTI: HC$3.00/MF$0.65

The basic research concerned the different stages of the reprocessing cycles envisaged. The effect on the output and sintering of the reprocessed powders of the PuO_2 content in fission products and in alumina (used in the fluid-bed technique) was examined. Various cycles were compared. The preferential sublimation of uranium and plutonium was investigated. Tests were effected relative to the chemical decanning of nuclear fuels. Tests were made of the fluorination of nuclear fuels by different fluorinating agents used alone or mixed together. The relative reactivities of the different mixtures were determined. Research was conducted on the absorption of fluorinating agents by solid substances (more compact and easier to handle and store than alkaline solutions) with a view to removing surplus reagents. Fission products capable of being volatilized during the fluorination stage were determined and their absorption by various solid compounds with a view to separating them from uranium and plutonium was investigated. The construction and the equipment of the various laboratories were continued. Author (NSA)

N68-12606# Mellon Inst., Pittsburgh, Pa. Radiation Research Labs.
RADIATION RESEARCH Quarterly Report, 1 Jul.–30 Sep. 1966
10 Oct. 1966 19 p refs *Its* Fundamental Res. No. 6041
(Contract AT(30-1)-2310)
(RRL-2310-188) CFSTI: HC$3.00/MF$0.65

Developments are reported for studies on: spectra and kinetics of tetravalent iron in pulse-irradiated ferric perchlorate solutions; argon-sensitized radiolysis of ethylene in liquid phase; radiation chemistry of liquid methane; theory of structure of the PF_4 radical; electronic structures of NCN and CNC; hydroxyl radical oxidation of ferrous ion by pulse radiolysis of nitromethane in aqueous solutions; spectra of oxygen-containing transient species; radioinduced hydroxylation of aromatic compounds in aqueous solutions; gas phase reactions of O^-; Hg ($^1P_1$)-photosensitized decomposition of cyclobutane; addition of hydrogen atoms to ethylene in liquid hydrocarbons; electron capture yields in radiolysis of hydrocarbon solutions; ESR studies in irradiated SF_6; and ESR observations on radicals in polar liquids. NSA

N68-12624# Polytechnic Inst. of Brooklyn, N. Y.
PROPERTIES AND APPLICATIONS OF MULTILAYER ELECTRODES Final Report, 1 Feb. 1966–31 Jul. 1967
H. P. Gregor 31 Jul. 1967 95 p refs
(Contract AT(30-1)-2279)
(NYO-2279-3) CFSTI: HC$3.00/MF$0.65

Progress is reported on: composition of long-chain carboxylate and phosphate multilayers from substrates containing Ca, Na, and K; properties of long-chain phosphorus acid monolayers; construction and properties of multilayer membrane electrodes; and differential free energies of hydration of ions at low hydration numbers. NSA

N68-12630# Mound Lab., Miamisburg, Ohio.
TRITIUM REMOVAL FROM GASES
J. P. Poitras 30 Sep. 1966 18 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1389) CFSTI: HC$3.00/MF$0.65

The tritium concentration of a gas mixture consisting primarily of helium was reduced from 10^{-2} mole percent to 2×10^{-12} mole percent. Adsorption experiments on activated charcoal at 77 and 4.2°K were conducted using various traps, and the results compared. Adsorption on charcoal at 77°K, with traps of large surface areas, was most efficient and practical. The tritium was then removed from the gas (mainly air) which had been cryogenically adsorbed by the charcoal. This was done by using a catalyst, Hopcalite, heated to 725°C, to form tritiated water which was then adsorbed on a molecular sieve. Author (NSA)

N68-12632# Tracerlab, Inc., Waltham, Mass. Technical Products Div.
MICROWAVE SPECTROSCOPY AND ITS APPLICATION TO THE USE OF NEUTRAL ISOTOPES IN PLACE OF RADIOACTIVE TRACERS

Joris M. Brinkerhoff 7 Oct. 1966 136 p
(Contract AT(30-1)-3339)
(NYO-3339-1) CFSTI: HC$3.00/MF$0.65

Various techniques of microwave spectroscopy were studied with reference to the use of neutral isotopes as tracer materials. A breadboard microwave spectrometer was constructed as a starting point. This was then modified to provide greater sensitivity through the use of long-term digital averaging of the output for a fixed frequency. Means were also studied for obtaining the high precision required to measure an increase in concentration of a given neutral isotope above its natural background. Considerable emphasis was placed on a study of means for generation of microwave power in the region of millimeter wavelengths. Special sample cells, including a multiple reflection cell, were constructed for this study. These cells proved quite successful. The levels of microwave power obtained, however, appeared inadequate to take full advantage either of the higher absorption coefficients obtained in the high frequency region or of the longer absorption path length obtained by the use of the multiple reflection cell. Special techniques of sample preparation and conversion were studied with particular reference to compounds of biological interest (such as amino acids). In this connection the total oxidation or reduction of the sample in an rf discharge (in an atmosphere of oxygen or hydrogen respectively) appeared promising. A study was conducted of means for frequency control and stabilization. In this connection a special method was devised for provision of a stable baseline during a continuous frequency sweep. A design of spectrometer which appeared suitable for neutral isotope applications was formulated. This included provision for long-term digital averaging, an in-line reference cell for high precision of read-out, an out-of-line reference cell for frequency reference, and an automatic feedback loop for long-term frequency stabilization. Author (NSA)

N68-12644# California Univ., Berkeley. Lawrence Radiation Lab.
PREPARATION AND CRYSTALLOGRAPHIC ANALYSIS OF CALIFORNIUM SESQUIOXIDE AND CALIFORNIUM OXYCHLORIDE
J. C. Copeland (M.S. Thesis) Aug. 1967 42 p refs
(Contract W-7405-ENG-48)
(UCRL-17718) CFSTI: HC$3.00/MF$0.65

Three samples of the low-temperature, cubic, Mn_2O_3-type californium sesquioxide were prepared. Two of these samples, prepared by the hydrolysis of other californium compounds, gave the same lattice parameters, within the error limits, with the average lattice parameter being $a = 10.838 \pm 0.02$ Å. The third sample, reacted in oxygen, had the lattice parameter $a = 10.809 \pm 0.003$ Å. In an earlier study, the lattice parameter of an air-ignited oxide sample was significantly smaller than the parameter of the same sample after heating in hydrogen. If these differences in lattice parameter reflect varying stoichiometries, then this might be evidence for higher and/or lower oxidation states of californium. The exact stoichiometries of the oxide samples prepared in this study are not known. Three samples of californium oxychloride were prepared and studied by X-ray diffraction techniques. The CfOCl had the tetragonal PbFCl-type structure and gave the average lattice parameters $a = 3.956 \pm 0.002$ and $c = 6.662 \pm 0.009$ Å. The error limits reported for the lattice parameters of CfOCl and Cf_2O_3 from the hydrolysis reactions are based on a statistical analysis of the consistency of the group of measurements. The limits placed on the lattice parameter of the Cf_2O_3 sample from the reaction with oxygen represent the 95% confidence level and reflect the internal consistency of the data for that particular sample. Author (NSA)

N68-12663# Johns Hopkins Univ., Baltimore, Md. Lab. of Astrophysics and Physical Meteorology.
STRENGTH-HALF-WIDTH PRODUCTS OF SELF-BROADENED LINES IN THE 6.3 MICRON BAND OF WATER VAPOR Final Report
Dianne K. Prinz Jul. 1966 78 p refs
(Contract CWB-10899)
(PB-173429) CFSTI: HC$3.00/MF$0.65

Absorption spectra of ten self-broadened lines in the 6.3 micron band of water vapor were obtained using a 100 foot long absorption cell with water vapor concentrations between 0.0092 pr. cm and 0.042 pr. cm. With an optical path of 19800 cm, all of the lines were in the square root region of the curve of growth. A procedure for adjusting the 100% transmission line was devised which eliminated that part of the absorption due to wings of distant lines which was constant over the integration interval. The strength-half-width product for each of the ten lines was then obtained from the resultant curve of growth. The results are compared with other values in the literature; the limitations and implications of the adjusting procedure are discussed. Author

N68-12672# Mellon Inst., Pittsburgh, Pa. Radiation Research Labs.
RADIATION RESEARCH Quarterly Report, Oct. 1–Dec. 31, 1966
16 Jan. 1967 10 p Submitted for publication *Its* Fundamental Res. No. 6041
(Contract AT(30-1)-2310)
(RRL-2310-194; Q-36) CFSTI: HC$3.00/MF$0.65

Developments are reported for studies on: role of O^- in gas phase radiolysis of alkane–nitrous oxide mixtures; radioinduced hydroxylation of nitrobenzene in dilute aqueous solution; yield of thermal ethyl radicals from radiolysis of ethylene–cyclohexane solutions; Meisenheimer complexes of dinitro substituted aromatic ethers; ESR spectra of irradiated plastic crystals; spin relaxation in radioinduced radicals; theory of structure of PF_4 radical; electronic structures of NCN and CNC; reaction of O^- with alcohols in gas phase; EPR spectra of irradiated aqueous solutions; pulse radiolysis of solvated electron; pulse radiolysis of ions in organic media; and the reaction of O^- with N_2O and CO_2 in liquid cyclohexane. NSA

N68-12681# Atomic Weapons Research Establishment, Aldermaston (England).
THE FORMATION OF BERYLLIUM CARBIDE DURING THE CORROSION OF BERYLLIUM IN CARBON MONOXIDE AND IN CARBON DIOXIDE GAS
V. D. Scott [1967] 5 p refs
(NP-17026; SRM-Memo-11/59) CFSTI: HC$3.00/MF$0.65

Recent work by Jepson and Antill with radioactive CO and CO_2 has shown that carbon is deposited on Be heated in these gases under static conditions. Two typical specimens (reacted at 700°C) from that work have been examined by optical and electron microscopy, and by electron diffraction. The diffraction pattern shows rings due to the presence of BeO plus three extra rings. Using the oxide rings for calibration, these extra rings were found to have d-spacings of 2.51A, 1.55A and 1.31A, in close agreement with the 2.51A, 1.53A, and 1.31A given by published X-ray work on Be_2C. Microscopical studies showed that the carbide particles are dispersed within the oxide layer. Author (NSA)

N68-12689# California Univ., Berkeley. Lawrence Radiation Lab.
IONIC RECOMBINATION IN WEAKLY IONIZED GASES
George A. Fisk (Ph.D. Thesis) Sep. 1966 66 p refs
(Contract W-7405-ENG-48)
(UCRL-17185) CFSTI: HC$3.00/MF$0.65

A study was made of ionic recombination rates in the lead iodide, lead bromide, and thallium iodide systems. The pressure dependence of the ion–ion recombination coefficient α was studied in the lead iodide system at 594°K and in the lead bromide system at 707°K. In both cases xenon at pressures up to 150 torr and argon at pressures up to 400 torr were used as third body gases.

In all cases the recombination coefficient could be expressed as $\alpha=\alpha_0+\alpha' \times N$ where N is the number density of the third body gas (atoms/cm^3). For lead iodide $\alpha_0=3.7\times10^{-8}$(cm^3/sec), $\alpha'=9.3\times10^{-27}$(cm^6/sec) in argon, and $\alpha'=19.1\times10^{-27}$ in xenon. For lead bromide $\alpha_0=5.3\times10^{-8}$, $\alpha'=15.3\times10^{-27}$ in argon, and $\alpha'=20.6\times10^{-27}$ in xenon. Currently available theories do not predict these values. The temperature dependence of α was studied in the thallium iodide system over the range from 484 to 728°K. No simple theoretical or empirical expression describes the dependence of α on T over this range, although α decreases with increasing temperature over most of the range, as predicted by theory. Author (NSA)

N68-12719# Union Carbide Nuclear Co., Oak Ridge, Tenn. Gaseous Diffusion Plant.

SEPARATION AND ANALYSIS OF NATURAL WATER

William T. Lammers 17 Aug. 1966 23 p refs Presented at 52d Ann. Meeting of the Am. Chem. Soc., New York, Sep. 1966

(Contract W-7405-ENG-26)

(K-L-6119; CONF-660907-2) CFSTI: HC$3.00/MF$0.65

The separation and determination of suspended and colloidal sized organic particles typically found in natural water are discussed. However, the same theories and general methods apply to similar particles in other fluids and to inorganic particles. Also, an assessment was made of what was known of the chemical, biological, and physical characteristics of suspended, colloidal, and dissolved particles reported in natural water. The fractions isolated by the techniques outlined are characterized by suitable analytical techniques to determine both the size of the fraction (number of particles) and the identity of the particles in the fraction. NSA

N68-12725# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.

REACTION CONSTANTS, IN CYCLOHEXANE, OF LAURYLAMINES WITH TETRABROMOPHENOLPHTHALEIN MAGENTA E ACID [CONSTANTES DES REACTIONS, EN MILIEU CYCLOHEXANE, DES LAURYLAMINES AVEC L'ACIDE TETRABROMOPHENOLPHTALEINE MAGENTA E]

Jean-Jacques Perez Nov. 1966 32 p refs In FRENCH

(CEA-R-3118)

Tridodecylamine is an extracting agent used for plutonium purification. Its main degradation product is didodecylamine. Titration of this impurity was carried out by spectrocolorimetry in cyclohexane using tetrabromophenolphthalein Magenta E as colored acid indicator. The dissociation constants reported for alkoylammonium salts are too close to lead to a discrimination between secondary and tertiary amines. The spectrophotometric results showed that the ratios of various dissociation constants for tetrabromophenolphthalein Magenta E salts are notably different from those for salts of simple colored acids like 2,4 dinitrophenol. The structural changes accompanying the colorations are discussed in order to explain this phenomenon. Author (NSA)

N68-12752# Commissariat a l'Energie Atomique, Chusclan (France). Centre de Production de Plutonium de Marcoule.

DECONTAMINATION OF INSTALLATIONS IN THE IRRADIATED FUEL PROCESSING PILOT-PLANT [DECONTAMINATION DES INSTALLATIONS DE L'ATELIER PILOTE DE TRAITEMENT DES COMBUSTIBLES IRRADIES]

Gerard Cohendy, Claude Ribes, Fernand Niezborala, and Josel Le Bouhellec Oct. 1966 28 p In FRENCH

(CEA-R-3104)

Procedures used in the decontamination of 9 cells of the irradiated fuel processing pilot plant are described. The operations resulted in internal decontamination of circuits and external decontamination of cell apparatus and the cells themselves. The decontaminating agents used for the rinsings were principally nitric acid and sodium carbonate, sometimes mixed with tartaric acid. Sodium fluoride in nitric acid solution and EDTA in alkaline solution. The decontaminating effect of sodium fluoride on zirconium and of EDTA on ruthenium and cerium was verified. NSA

N68-12759 Kernforschungsanlage, Juelich (West Germany).

EXAMINATION OF THE CHEMICAL AND PHYSICAL PROPERTIES OF THE ELEMENT TECHNETIUM [UNTERSUCHUNGEN UEBER DIE CHEMISCHEN UND PHYSIKALISCHEN EIGENSCHAFTEN DES ELEMENTS TECHNETIUM] Final Report, 1 Nov. 1964–31 Oct. 1966

Brussels EURATOM 31 Oct. 1966 34 p refs In GERMAN

(Contract EURATOM-064-64-10 RISD)

(EUR-3641.D) CFSTI: HC$3.00

The diffusion coefficient of the TcO_4 ion for 25.0°C was calculated on the basis of conductivity measurements in $KTcO_4$ solutions as being $D_0=1.48\cdot10^{-5}$ cm$^2\cdot$sec^{-1}. The self-diffusion coefficients of the pertechnetiate ion in the presence of basis electrolytes could only be determined by the capillary method. For 10^{-3} m TcO_4 the results were $D=1.27\cdot10^{-5}$ at 25°C in a 1-mole sodium lye solution and $D=1.24\cdot10^{-5}$ cm$^2\cdot$sec^{-1} in a 1-mole LiCl solution. After direct-current polarographic measurements, four reduction stages of TcO_4 with half-stage potentials at 0.8V, 1.1V, 1.6V and 1.7V occur in alkaline basic electrolytes. The electron transfers $n\cong2$, corresponding to Tc(VII) → Tc(V) and $n\cong3$, corresponding to Tc(VII) → Tc(IV) can be associated with the proportional concentration stages at 0.8V and 1.1V. Stages 3 and 4 are of a catalytic nature. From an alternating-current polarographic standpoint, four waves can be ascertained. The reversibility measurement for the first wave at 0.8V gave alternating current yields from 70% to 90% depending on the nature and concentration of the basic electrolytes. The underlying electrode process in the case of the second wave is also to all intents and purposes reversible. Author

N68-12763# Virginia Polytechnic Inst., Blacksburg. Dept. of Chemistry.

DERIVATIVES OF PENTAFLUOROSULFANYLAMINE, SF_5NH_2

A. F. Clifford, G. R. Zeilenga, and R. G. Goel 1966 6 p refs Presented at the 4th Intern. Fluorine Symp., Estes Park, Colo., 24–29 Jul. 1967

(Contract AT(40-1)-3603)

(CONF-670722-1) CFSTI: HC$3.00/MF$0.65

The reaction of SF_5NH_2 and SF_4 provides an improved method for the preparation of $SF_5N=SF_2$. Fluorination of $SF_5N=SF_2$ with AgF_2 gives largely SF_6 and N_2, but with F_2 the reaction is complex giving the new compound $(SF_5N=)_2SF_2$ as one product. The reaction of SF_5NH_2 with SCl_2 gives $SF_5N=SCl_2$, a yellow, highly reactive liquid which attacks mercury and reacts with AgF_2 to give $SF_5N=SF_2$. The reaction of NSF_3 and ClF yields pentafluorosulfanyldichloroamine, SF_5NCl_2. The compound is a light yellow liquid with a boiling point of 64°C and a melting point of −120°C. It is sensitive to mechanical shock and is thermally unstable at 80°C. Hydrolysis and the reaction of SF_5NCl_2 with mercury were slow. Author (NSA)

N68-12790# Army Nuclear Defense Lab., Edgewood Arsenal, Md.

A COMPUTER PROGRAM FOR KINETIC TREATMENT OF RADIATION CHEMICAL DATA

Nathan Klein Jun. 1967 26 p Supported in part by AEC

(NDL-TM-36; AD-654502)

The computer program described in this report was designed to help the radiation chemist kinetically evaluate his data, although

the program, PR III, was specifically designed for data evaluation in pulse radiolysis, it may be modified to process data obtained with much lower dose rates than those encountered in pulse radiolysis, e.g. radioactive isotope radiation sources. The program assumes that all reactive species are homogeneously distributed in solution and requires as input the initial concentration of all species that will "react" during the course of the calculation. In addition, the yield of all species produced by the radiation is a required input. TAB

N68-12791# Los Alamos Scientific Lab., N. Mex.
ANION-EXCHANGE PROCESSING OF PLUTONIUM
Dean B. James 20 Jan. 1967 68 p refs
(Contract W-7405-ENG-36)
(LA-3499) CFSTI: HC $3.00/MF $0.65

A review is presented of the nitrate solution, anion-exchange technique for the purification and concentration of plutonium, emphasizing the chemical and chemical engineering nature of the process. The fundamentals of ion exchange and the solution chemistry of plutonium are reviewed. The basic chemistry of the nitrate, anion exchange of plutonium is described along with the applied process. Author (NSA)

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N68-11921*# Purdue Univ., Lafayette, Ind. Electronic Systems Research Lab.
DIGITAL COMMUNICATION SYSTEMS SUBJECT TO FREQUENCY SELECTIVE FADING
John C. Lindenlaub and Charles C. Bailey Nov. 1967 174 p refs
(Grant NsG-553)
(NASA-CR-91078; TR-EE67-17) CFSTI: $3.00 CSCL 17B

This research is concerned with the effects of frequency selective fading on binary digital communication systems and with a method of alleviating some of these effects. The frequency selective fading is assumed to be describable in terms of a filter whose transfer function is a sample function from a complex Gaussian random process. Matched filter detection at the receiver is assumed to be employed. Although the analytical methods used in this report are general, DPSK signaling is assumed for all the quantitative results. In order to determine the probability of error for this system, a technique due to Bello and Nelin is used. Author

N68-11924# Danish Academy of Technical Sciences, Copenhagen. Microwave Lab.
EFFECT OF DEVIATION FROM THE IDEAL PARABOLOID SHAPE OF LARGE ANTENNA REFLECTORS
J. H. Wested 15 May 1966 8 p ref Presented at the Conf. on the Design and Construct. of Large Steerable Aerials, London, 6-8 Jun. 1966
(P-2146) CFSTI: HC $3.00/MF $0.65

The manufacturing tolerances of large parabolic reflector surfaces reduce the efficiency and increase the power-scattering which gives a reduced signal and an increased noise pick-up. In the present work an approximate theory is given which extends Ruze's flat reflector theory to be valid for deep reflectors with nonuniform illumination function and nonuniform statistical surface deviations. Obviously, the influence of the depth of the parabolic reflector has been overlooked in many reported calculations on large antennas leading to too pessimistic results for the predicted degradation of radiation pattern caused by the surface deviations. Author

N68-11941# General Precision, Inc., Pleasantville, N. Y. GPL Div.
STUDY AND DEVELOPMENT OF TELEVISION PROJECTOR VIDEO AMPLIFIER TECHNIQUES Final Report, Jul. 1965-Oct. 1966
C. V. Girod, Jr. and L. L. Pourciau Wright-Patterson AFB, Ohio AMRL Jul. 1967 56 p refs
(Contract AF 33(615)-2959)
(AMRL-TR-67-61; AD-660912)

To determine the most suitable technique to provide a wideband (30-mc) high level (150 volts, peak-to-peak) video amplifier for use with experimental and developmental television projectors, various techniques for obtaining wideband amplification were investigated. The techniques investigated were: shunt, series and combination peaking, distributed amplification, negative feedback, and modulated radio frequency carrier. The primary problem was that of providing wideband amplification and high output level to a load that consisted of a resistor in parallel with various unavoidable capacitances which result from state output capacitance, stray and wiring capacitances, and the input capacitance of the driven device. The capacitance limits the bandwidth of the amplifier, inversely proportional to the resistor-capacitance product. The study resulted in the design and construction of a solid-state video amplifier, employing a combination of feedback and peaking techniques, which meets the required performance characteristics. The amplifier provides a bandwidth of 30 Hz, a gain of 300 and an output capability of 150 volts. Author (TAB)

N68-11971# Innsbruck Univ. (Austria).
THE HELICAL ANTENNA AND ITS PROBLEMS Scientific Report, 1 Jul. 1965-1 Jan. 1967
Wolfram Bitterlich 1 Mar. 1967 40 p refs
(Contract AF 61(052)-902)
(AFCRL-67-0358; SR-1; AD-660543)

Problems are discussed which result from the use of helical antennas in a dissipative medium at low frequencies. A network model for helical antennas surrounded by rock with the conductivity sigma and the dielectrical constant epsilon, is used for deriving theoretical expressions for the real part and imaginary part of the input impedance in the case of quasistationary currents. The field structure to be expected and the different types of propagation are discussed in brief. The antennas examined by experiment are described and the measured results are compared with the theoretical values. Author (TAB)

N68-11973# Air Force Cambridge Research Labs., Bedford, Mass.
A SATELLITE-TO-SATELLITE HF IONOSPHERIC PROPAGATION ENVIRONMENT STUDY
J. Videberg, M. S. Wong, and G. M. Daniels Jun. 1967 82 p refs
(AFCRL-67-0374; AD-660921)

A critical study of the interrelationship between ionospheric environmental characteristics and HF radio propagation phenomena using satellites is described. The project is implemented by the experimant consisting of two slowly-separating satellites in the

lower F-region ionosphere and two special receiving-transmitting ground stations. Measurements of radio propagation characteristics are made along the signal path between satellites as well as to the ground until separation reaches antipodability. These measurements including signal loss, pulse dispersion, long-range ducting, radio holes and shielding from ground, space, or other satellites to be compared with calculations based on simultaneous environmental measurements are discussed. Environmental data to be measured includes in-situ electron densities, integrated values along signal paths near ground stations using dispersive doppler, Faraday, and pulse-delay techniques. Top and bottom sounder data will be combined with the propagation data using sophisticated 3-D ray-tracing techniques. The result is a comprehensive synoptic picture of the complex ionosphere-structure propagation-effect to provide new insights into ducting, especially the separation of various phenomena such as injection-ejection, scatter effects, antenna detuning and plasma resonances, and the role of irregularities. Predicted propagation results, including ray patterns, calculated for expected ionospheric conditions at the time of the anticipated experiment are presented together with a description of the instrumentation. Author (TAB)

N68-11980# RAND Corp., Santa Monica, Calif.
SATELLITE SEPARATION AND THE ALLOCATION AND SPECIFICATION OF SHARED SPECTRUM USAGE FOR INTENSE EXPLOITATION
J. L. Hult Oct. 1967 13 p Paper on Satellites for Domestic Commun. Purposes given at Los Angeles, 24 Oct. 1967; Sponsored by the Electron. Ind. Assoc.
(P-3712; AD-660835)

The article explores briefly what the technological limits may be to the orbital and spectrum capacity that could be achieved with coordinated, regulated use. Some areas of technological development are highlighted that appear particularly attractive and some approaches to policy and regulation are suggested. The comments concern the spectrum above 3400 MHz and the sharing between terrestrial microwave relay and satellite relay for fixed and mobile services, including direct broadcast from satellites. TAB

N68-11995# Air Force Cambridge Research Labs., Bedford, Mass. Microwave Physics Lab.
THE EFFECT OF A FOREGROUND RIDGE ON THE GAIN AND PATTERN OF AN ANTENNA Interim Scientific Report
Allan C. Schell and John A. Strom Aug. 1967 24 p refs
(AFCRL-67-0454; RP-338; AD-660807)

Using a simplified antenna model on a ground plane and various sizes and types of ridges, the effects of a ridge obstruction in the foreground of a directive antenna have been investigated in a series of experiments at X band. Curves of the effects of a ridge at distances of 5 wavelengths to 80 wavelengths are given. Equations for the pattern of an antenna and lossy ridge are derived. The calculated patterns show good agreement with the measured results. Author (TAB)

N68-12015# Navy Underwater Sound Reference Lab., Orlando, Fla.
REDUNDANCY IN BINARY PATTERNS
William H. Jermann 5 Oct. 1967 19 p refs
(USL-854; AD-661228)

Suppose that it is desired to assign a measure of information, average information per symbol, or redundancy to a finite-length sequence of symbols. Two approaches to this problem are considered. The sequence can be treated as a representative sample from a Markov information source, and the average information content per symbol can be determined for the source. The second method is to consider the sequence as a sample space from which subsequences can be randomly selected. A measure of information content can be determined from the subsequence probabilities. Author (TAB)

N68-12029# Johns Hopkins Univ., Baltimore, Md. Dept. of Electrical Engineering.
REPRESENTATION AND ANALYSIS OF SIGNALS. PART 24: STATISTICAL ESTIMATION OF INTRINSIC DIMENSIONALITY AND PARAMETER IDENTIFICATION
Gerard V. Trunk Jun. 1967 122 p refs Sponsored in part by NSF
(Contract Nonr-4010(13))
(AD-661210)

A statistical method for estimating the intrinsic dimensionality of a signal collection was derived through the principle of invariance. Since multiple hypothesis testing yields a likelihood rule, the probability of correct decision is maximized if the assumptions made are true. However, since some of the assumptions are false, one cannot make the statement that the statistical method has probability of error less than the previous methods. By finding the intrinsic dimensionality before and after the use of a group of appropriate transforms, a specific set of parameters can be identified. While only a few parameters have been identified by this method, their general form insures a wide instance of occurrence. Finally, a signal-to-noise ratio is defined for a collection of signals; and a filtering process, by subgrouping, is based on an estimate of this ratio. Author (TAB)

N68-12032# Harvard Univ., Cambridge, Mass. Cruft Lab.
ADMITTANCE OF A THICK MONOPOLE DRIVEN FROM A COAXIAL LINE Interim Scientific Report
David C. Chang and Tai Tsun Wu Sep. 1967 27 p refs
(Contracts AF 19(628)-2406; Nonr-1866(32))
(AFCRL-67-0533; SR-20; AD-660547)

The apparent input admittance of an infinitely long, thick monopole driven from a low-impedance coaxial line is found analytically. The so-called capacitive end-correction of an antenna driven by an external delta-function generator is then expressed in a very simple form. The theoretical results thus found agree very well with the experimental measurements. Author (TAB)

N68-12055# Johns Hopkins Univ., Baltimore, Md. Dept. of Electrical Engineering.
REPRESENTATION AND ANALYSIS OF SIGNALS. PART 25: PROPERTIES OF NON-GAUSSIAN, CONTINUOUS PARAMETER, RANDOM PROCESSES AS USED IN DETECTION THEORY
Percy A. Pierre Aug. 1967 178 p refs
(Contract Nonr-4010(13))
(AD-661211)

The conclusions of the report are: (1) The expansion coefficients of some common representations of random processes will be independent only when the process is Gaussian; (2) Processes representable on a particular interval in terms of a denumerable sequence of independent random variables will often have sample function properties similar to those of the Gaussian process; (3) The quadratic variation of non-Gaussian processes with sufficiently smooth cumulants is constant for a given interval; (4) The quadratic variation of a non-Gaussian linear process equals the sum of the squares of its jump discontinuities; (5) There is a class of sequences of functionals, say T sub N(x(t)), such that l.i.m. T sub N equals the quadratic variation of the processes in (3). (6) The necessary and sufficient condition for singular detection of a sure signal in Gaussian noise is sufficient for singularity when the noise is any mean square continuous process. (7) Regularity or

singularity for signals depending on a random parameter, gamma, is implied by regularity or singularity for signals corresponding to each possible value of gamma when gamma has a discrete distribution or the noise is Gaussian. (8) Singular estimation of certain parameters is sometimes possible under the conditions of singular detections. (9) Some of the spectral conditions which imply singularity for Gaussian random processes continue to imply singularity for non-Gaussian processes with sufficiently smooth cumulants. (10) For other non-Gaussian processes, spectral conditions are irrelevant. TAB

N68-12069* Pittsburgh Univ., Pa. Space Research Coordination Center.

ON RECOGNITION OF HANDWRITING CHINESE CHARACTER

C. C. Li, T. L. Teng, M. J. Zobrak, and T. W. Sze 22 Nov. 1967 9 p refs Presented at the 1st Ann. Princeton Conf. on Inform. Sci. and Systems, 1967

(Grant NsG-416)

(NASA-CR-91048; SRCC-60) CFSTI: $3.00 CSCL 09D

The direction-time coding method is used to extract some important features of handwritten Chinese characters. The horizontal and vertical coordinates of the strokes in a character are sequentially stored as the character is written. An automatic method is developed to divide the strokes into a suitable number of segments for calculating the direction numbers of individual segments which abstract the given character into a corresponding pattern vector of a specified dimension. With a given set of prototype patterns, a learning algorithm is applied to recognize the handwritten Chinese characters. A computer simulation study on a few characters indicates that the proposed approach is promising. Author

N68-12078# Stanford Univ., Calif. School of Engineering.

ADVANCED SYSTEM FOR COMMUNICATIONS AND EDUCATION IN NATIONAL DEVELOPMENT Final Report

Jun. 1967 424 p refs

This report presents a brief summary of the preliminary design of communication and educational television satellites for Brazil, India, and Indonesia. The complete study shows how educational television via a satellite can be integrated into the nation's educational programs, and how satellite techniques can be phased into present and future communications systems. The technical study includes an optimized design of a synchronized, fully stabilized satellite with 1 kW of rf power. It also includes detailed design of ground receivers to minimize overall systems cost for television, facsimile, and two-way voice communications. The study demonstrates that the technology is entirely capable of providing such a system at a cost which is a small fraction of what several of the countries are now spending for education. Author

N68-12104# Texas Univ., Austin. Electrical Engineering Research Lab.

PROPAGATION CHARACTERISTICS OF MICROPULSATIONS Final Report

M. G. Bloomquist, H. W. Smith, F. X. Bostick, Jr., Leon A. Ames, and Arnold Orange 1 Aug. 1967 166 p refs

(Contract AF 19(628)-4046)

(AFCRL-67-0540; AD-661284)

Simultaneous earth current measurements were made during August and September, 1965 at Ashland, Maine; Huancayo, Peru; Dillingham Air Force Base, Hawaii; and Manila, Philippines. The purpose of the measurements was to provide accurate, reliable data for a study of the worldwide propagation of micropulsations. A method was developed to estimate, by computerized analysis of the data, the difference in arrival time of coherent energy (group delay) at the respective stations. The accuracy limits imposed upon these measurements by the equipment and local geologic conditions have been investigated. Confidence levels of coherence were examined. A method of measuring differences between stations of polarization sense and direction has been derived. TAB

N68-12121# Lincoln Lab., Mass. Inst. of Tech., Lexington.

A RESYNCHRONIZATION TECHNIQUE FOR A SEQUENTIAL DECODER

George Blustein 24 Oct. 1967 15 p

(Contract AF 19(628)-5167)

(ESD-TR-67-547; TN-1967-45; AD-660865)

The report proposes a resynchronization technique for a Fano type sequential decoder. The method does not use repeat-request feedback or periodic restarting and is only employed when a buffer overflow indicates a very noisy channel condition. A program was written to execute this algorithm for a simulated Gaussian channel for several values of E/N sub o. The results imply that this is a feasible resynchronization scheme. Author (TAB)

N68-12134# Innsbruck Univ. (Austria).

DETERMINATION OF THE MEAN VALUES OF CONDUCTIVITY AND DIELECTRIC CONSTANT FROM THE FIELD STRUCTURE OF A MAGNETIC DIPOLE Scientific Report, Oct. 1966–Jun. 1967

Walter Kellner 20 Jun. 1967 39 p refs

(Contract AF 61(052)-902)

(AFCRL-67-0494; SR-4; AD-660544)

The equations for a magnetic dipole in a homogeneous, conductive medium are analyzed. The field is shown to be elliptically polarized in the transition zone between near field and far field. Quantities are introduced which are easy to determine by experiment; from them, the complex propagation constant can be determined at a given distance. Thus, conductivity and dielectric constant can be calculated for a given frequency. The applicability of this method is confined to the region of validity of the basic expressions. This comprises the condition that the cavity which contains transmitter and receiver is small as compared to the wave-length in matter. Measurements at 120 kc/sec satisfied this condition. The principle of measurement and its evaluation are described. The results are compared with results obtained from natural rock samples. Author (TAB)

N68-12182# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE PROPAGATION OF RADIO WAVES ALONG THE SURFACE OF THE EARTH

Ye. L. Feynberg 23 Mar. 1967 761 p refs Transl. into ENGLISH from the book "Rasprostranenie Radiovoln Vdol Zemnoy Poverkhnosti" Moscow, Izd. Akad. Nauk SSSR, p 1–546

(FTD-HT-66-264; AD-660951)

The monograph covers all the basic subdivisions of the theory of surface radiowave propagation, that is, of radio waves, for which the role of the ionosphere is immaterial. A theory is expounded for the plane and the spherical radio waves, alongside with the theory of events induced by the electrical inhomogeneity and the irregularity of the surface constituting the divide between the ground and the atmosphere, and that of the influence of the stratified inhomogeneity of the troposphere; described also are the methods of accounting for the effects connected with its turbulence. Topics included are: Basic equations; Region of space essential for the process of radiowave propagation; Propagation of radio waves in uniform media and refraction on the plane boundary of the interface; The field near the plane interface between the ground and the atmosphere; Dipole near a plane ground surface; Dipole near a spherical ground surface; Field above an electrically inhomogeneous ground surface; Propagation of radio waves over an uneven surface; Propagation of radio waves in a layerwise-inhomogeneous medium; Propagation of radio waves in a turbulent atmosphere. TAB

N68-12197# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON DETERMINING THE MEAN SQUARE ERROR OF INTERPOLATION DURING THE DISCRETE MEASUREMENT OF RANDOM SIGNALS [K OPREDELENIYU SREDNEKVADRATICHESKOY OSHIBKI INTERPOLYATSII PRI DISKRETNOM IZMERENII SLUCHAYNYKH SIGNALOV]

Yu. M. Bykov 18 Aug. 1967 25 p refs Transl. into ENGLISH from the Publ. "Kompleksnaya Avtomatizatsiya Khimicheskikh Proizvodstv" Moscow, Mashgiz., v. 25, 1963 p 138–150
(FTD-MT-65-326; AD-660738)

An equation was derived which, as an extremely common result, makes it possible to determine the mean-square error in discrete measurement in any frequency bands and with any forms of interpolation, for which the analytic expression of the corresponding transfer function can be obtained. The possibility of approximate application methods of the mean-square error expression were considered; the most evident approximation (and one which considerably facilitates the calculation of this expression in practical cases) is the substitution of the real spectral density of the signal by a uniform spectrum in a band with an upper limiting frequency of a max. The possibility of the practical application of this approximation and its effect on the result obtained were investigated on the basis of a concrete interpolation form, for which, using expression (2), the theoretical dependence of the mean-square error on the reading frequency with a signal of uniform spectrum was determined. Stepwise interpolation was considered. Author (TAB)

N68-12220# New York Univ., N. Y. Lab. for Electroscience Research.

STATISTICAL DESCRIPTION OF A CLASS OF NONGAUSSIAN CHANNELS USING EXPANSIONS BASED ON THE LOGNORMAL DISTRIBUTION

Dirk R. Klose and Ludwik Kurz Jun. 1967 66 p refs
(Contract AF 19(628)-4321; Grant NSF GK-1075)
(TR-400-162; AFCRL-67-0432; SR-7; AD-660807)

To develop improved detection procedures for the extraction of digital data from a background of nongaussian noise, it is necessary to obtain improved representations for a class of nongaussian processes. In this report a new representation theory based on the deviations from a lognormal distribution is developed. Two conceptually different representations are presented. These improved representations are particularly useful in obtaining a more complete description of the statistics for multi-hop and tropospheric scatter communication links. By the proper application of this new and flexible representation theory it is shown that one can develop improved detection procedures. The detectors based on the new representation can be adjusted to perform optimally for a large class of nongaussian channels. Author (TAB)

N68-12281# Technical Univ. of Denmark, Lyngby. Lab. of Electromagnetic Theory.

REFLECTOR ARRAYS Final Scientific Report, 1 Apr. 1964–30 Jun. 1967

Erik Drago Nielsen 15 Jul. 1967 52 p refs
(Contract AF 61(052)-794)
(S-127-R-59; AFCRL-67-0578; AD-661324)

The Van Atta reflector was first described in a patent by Dr. L. C. Van Atta in 1959. The advantage of this passive reflector type should be that the reradiated field has a maximum back in the direction of arrival of the primary plane wave. Since this retrodirective effect of the reflector might be of great importance if used as a navigational aid in the air or at sea, it seemed worth while to carry out a theoretical investigation of such reflectors, especially since only experimental investigations had been made before this contract was initiated. The work performed dealt mainly with theoretical and numerical investigations of Van Atta reflectors consisting of dipoles. A survey of the literature concerning active or passive Van Atta reflectors was made. Both a linear and a two-dimensional plane Van Atta reflector was investigated numerically and a theory for arbitrary Van Atta reflectors was developed. An experimental investigation of a linear Van Atta reflector was carried out and the results compared with the theoretical results. Author (TAB)

N68-12294# Mitre Corp., Bedford, Mass.

ERROR CONTROL TECHNIQUES USING BINARY SYMBOL BURST CODES

Kenneth Brayer Sep. 1967 61 p refs
(Contract AF 19(628)-5165)
(MTP-55; ESD-TR-67-379; AD-660582)

Much has been written on the theoretical description of error correcting codes but, due to a lack of actual channel error patterns, little has been said of practical performance. In this paper the performance of three types of error control is evaluated for the case of independent random errors and for an actual channel exhibiting dense bursts. The selected codes are burst codes with high probabilities of error detection and correction. Author (TAB)

N68-12320*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

SCIENCE DATA SYSTEMS

In its Space Programs Sum. No. 37-47, Vol. 3 31 Oct. 1967 p 175–183 refs (See N68-12306 03-30)

The basic categories to which pulse compression schemes belong are described, and their possible applications to spacecraft image systems are discussed. The categories include Roberts coding, improved gray scale, coarse-fine PCM, series approximation, prediction and interpolation systems, variable sampling rate systems, differential systems, dual mode systems, and area coding systems. It is concluded that the differential and dual mode systems appear to offer the most promise for compression with high accuracy. Most low distortion systems must gain compression by optimum encoding of data. Such encoding is based on variable word length codes which have two disadvantages: they require indeterminate buffer storage in order to transmit (or store) the data on a fixed rate channel, and the amount of compression is strongly dependent on the data. If enough distortion can be tolerated, compression can be fixed (e.g., the coarse-fine system or a differential system with a tapered quantizer). This is a real advantage in that buffering requirements are eliminated, and the mission profile can be predetermined. C.T.C.

N68-12324*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

COMMUNICATIONS SYSTEMS RESEARCH

In its Space Programs Sum. No. 37-47, Vol. 3 31 Oct. 1967 p 213–236 refs (See N68-12306 03-30)

Optimum frame synchronization for coded communication systems and some properties of arithmetic norms in information processing are discussed. In the first area it is noted that the Mariner Mars 1969 high rate telemetry channel is being designed to transmit data encoded into 6-bit biorthogonal code words. The proposed frame synchronization scheme involves inserting into each frame of 972 bits (162 words) a total of 52 bits (approximately 9 words) for purposes of framing and labeling. It is demonstrated that this much redundancy, if properly utilized, can provide very rapid frame synchronization even at extremely adverse signal-to-noise ratios, and that considerably less redundancy is needed if slightly longer synchronization delays can be tolerated. In the second area the properties of the radix-r norm, used in arithmetic checking and correcting codes, are investigated. Both the special case of $r=2$ and the general case of radix-r are examined. An algorithm for the computation of the norm of an arbitrary integer is generated, and a radix-r norm group is defined and its properties are established. The distribution of the norms for elements in a norm group is computed. C.T.C.

N68-12325*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

COMMUNICATIONS ELEMENTS RESEARCH

In its Space Programs Sum. No. 37-47, Vol. 3 31 Oct. 1967 p 237–258 refs (See N68-12306 03-30)

Communications elements research is reported in (1) the evaluation of an X-band maser input transmission line, (2) high-impact circular-cup radiator development, (3) large aperture spacecraft antenna development and (4) spacecraft antenna research dealing with radiation from a horizontal electric dipole in a circular plasma column. The results in the maser input transmission line analysis show the correlation between the predicted and measured maser noise temperatures, and also show the feasibility of accurately calibrating transmission lines that possess a relatively high mismatch. In the second area emphasis is placed on test results before and after impacts of 10,000 g's. In the large aperture spacecraft antenna development area a formulation is developed to calculate the scattered circularly polarized fields from a general reflector by surface current integration using point source circularly polarized illumination. In the last area electromagnetic radiation by an off-axis horizontal diopole in a cylindrical homogeneous plasma column is discussed. C.T.C.

N68-12326*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACECRAFT TELEMETRY AND COMMAND
In its Space Programs Sum. No. 37-47, Vol. 3 31 Oct. 1967 p 259–267 refs (See N68-12306 03-30)

Consideration is given to a miniature brushless dc motor for spacecraft applications, and to the design of a block encoder. A description is given of motor, advantages and disadvantages over conventional motors are discussed, and preliminary performance characteristics are shown. In the second area the relative merits of block coding for a digital communication channel are enumerated, and a hardware design that performs the selected encoding function is described. This design uses a low power diode-transistor logic integrated circuit (IC) line and is accomplished with 29 ICs. C.T.C.

N68-12327*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACECRAFT RADIO
In its Space Programs Sum. No. 37-47, Vol. 3 31 Oct. 1967 p 269–278 refs (See N68-12306 03-30)

Relay link radio frequency system development, the Mark I ranging code spectrum, and spacecraft power amplifier development are discussed. In the first area emphasis is placed on the development of a solid state 400-MHz prototype transmitter for a capsule-to-spacecraft link in support of anticipated Mariner and Voyager requirements. The ranging area discusses an analysis to determine a mathematical representation for the power spectrum of the ranging code. The last area discusses the development of a 100-watt, S-band, traveling wave tube as part of a power amplifier program. C.T.C.

N68-12366# Sandia Corp., Livermore, Calif.
FORTY-CHANNEL PORTABLE FM DATA ACQUISITION SYSTEM
J. D. Porter Apr. 1967 3 p
(Contract AT(29-1)-789)
(SCL-TN-67-33) CFSTI: HC $3.00/MF $0.65

A portable 40-channel FM (frequency modulation) system, consisting of voltage-controlled oscillators, signal conditioners, amplifiers, and test equipment, is described. The system was designed to provide an efficient means for acquiring transducer data at locations not easily serviced by existing data centers. The FM system, which is 29×51×73 inches in size, can be moved about easily within a building, but should be transported between locations by a truck or forklift to prevent vibration damage. The system is capable of recording 20 channels of either strain gage, bridge-type, or swept resistance-type transducer data, or combinations of these types; and 20 channels of either voltage monitors, current monitors, or accelerometer data from charge amplifiers, or combinations of these types. The portable system, designed for simplicity of operation rather than maximum versatility, can be quickly set up and calibrated. By limiting the versatility, the setup time and operator error have been considerably reduced. Author (NSA)

N68-12484 Joint Publications Research Service, Washington, D. C.
SPIKES OF A NONSTATIONARY RANDOM PROCESS
G. A. Andreyev 4 Dec. 1967 12 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Radiofiz. (Gor'kiy), v. 10, no. 8, 1967 p 1123–1130
(JPRS-43551) CFSTI: $3.00

An expression is obtained for the average number of intersections in the interval [0, T] of a nonstationary normal random process of an arbitrarily varying determinant level with additively superimposed normal fluctuations. It is demonstrated that known expressions for the spikes of a stationary normal process the fixed level follow from the expression obtained as special cases. Author

N68-12543*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
A DATA HANDLING SYSTEM WITH EFFICIENT SYNCHRONIZATION FOR AN 8 BIT, BIORTHOGONAL TELEMETER
W. P. Barnes, B. W. Reich, and J. Y. Sos Nov. 1967 10 p refs
(NASA-TM-X-63043; X-563-67-555) CFSTI: HC $3.00/MF $0.65
CSCL 09F

An experimental data handling system for an 8 bit phase-coherent biorthogonal, coded PCM telemeter has been developed and evaluated. It performs the following major functions. The received RF carrier frequency is used as the master clock for the telemeter. Synthesis of the receiver oscillator frequencies yields a telemetry reference clock. Virtual elimination of data recovery degradation due to tape transport time displacement error is achieved by multiplexing the reference clock with the data and recovering it with a second-order phase lock loop. The phase lock loop output is used as the source of all timing in the data handling system. The system coherently accumulates synchronization energy over a sufficiently large number of frames, thus achieving arbitrarily low synchronization error probabilities. Author

N68-12659# Pan American World Airways, Inc., Patrick AFB, Fla. Guided Missiles Range Div.
THE RESULTS OF TESTING TEL 4 IN A REAL-TIME, PCM FM CONFIGURATION
P. L. Harton and J. W. McRary Patrick AFB, Fla. Radar Telemetry Branch Nov. 1966 77 p refs
(Contract AF 08(606)-7500)
(TM-61; ETR-TR-67-6; AD-659381)

A discussion of the way in which noise introduces errors in a PCM/FM link is followed by a description of test results. A summary of the test procedure is also included. The effect of time is reported for approximate periods of one day, three days, thirty days and six months. Performance comparisons are made between P-band and S-band operation, for several bit rates, and for two different message structures. All tests were performed, simultaneously, with a demultiplexer that uses a sampling detector and a second demultiplexer that uses an integration detector. Performance data were computer processed to accomplish a regression analysis for each set of test conditions. By this method a best-fit estimate of performance was obtained along with a measure of data precision. This systematized procedure permits a large number of measurements to be analyzed quickly, without human error or prejudice. Discussion includes some considerations of data-point scatter and suggests the use of a Poisson distribution for relating the number of errors counted to the probability of erroneous measurements. Author (TAB)

N68-12701*# Bissett-Berman Corp., Santa Monica, Calif.
LUNAR MODULE RELAY EXPERIMENT TRACKING ACCURACY STUDY Final Report
Jul. 1967 105 p refs
(Contract NASw-1591)
(NASA-CR-91071; MJO-3116) CFSTI: HC $3.00/MF $0.65 CSCL 17B

A tracking accuracy experiment considered earth insertion, translunar injection, and transearth mission phases in relation to the use of a synchronous satellite network. Apollo mission reference trajectories were used, and results indicate that the relay orbit inclination angle would not markedly affect command service/module (CSM) accuracy during these three phases. A study of CSM accuracy indicated that ship tracking was better than one relay for short tracking intervals, although two relays would perform significantly better than ship tracking. Implications of a synchronous relay network are discussed, along with the system concept, the technical approach used in performing this experiment, and some quantitative data. M.W.R.

N68-12753# Joint Publications Research Service, Washington, D. C.
ANTENNAS
S. I. Nadenenko 11 Dec. 1967 226 p refs Transl. into ENGLISH of the book "Antenny" Moscow, State Publishing House, 1959 p 238-435
(JPRS-43651) CFSTI: $3.00

The propagation characteristics and the requirements imposed on long wave, medium wave, short wave, and ultra short wave antennas are described. Design concepts and construction methods are discussed, and operating conditions are analyzed. Radiation patterns and their control are examined, and formulas are derived for calculating impedances. M.G.J.

N68-12758# Air Force Systems Command, Wright-Patterson AFB, Ohio.
DESIGNING A RADIATING SYSTEM ACCORDING TO A GIVEN RADIATION PATTERN
Ye. G. Zelkin 21 Mar. 1967 274 p refs Transl. into ENGLISH of the book "Postoyeniye Izluchayushchey Sistemy Po Zadannoy Diagramme Napravlennosti" Leningrad, Gosenergoizdat., 1963 p 1-271
(FTD-HT-66-262; AD-661032)

The book gives the theory and various methods of calculating radiation systems with a set radiation pattern. Topics included are: conditions for the existence of an exact solution for a linear radiator, solution of an integral equation for a linear radiator, linear array of radiators, approximate calculation of an antenna according to a given radiation pattern, phase of the radiation pattern, examples of designing antennas according to a given radiation pattern, plane radiators. TAB

N68-12783# New York Univ., N. Y. Lab. for Electroscience Research.
FIXED-WORD-DURATION, VARIABLE-DATA-RATE PROCEDURES FOR FEEDBACK COMMUNICATION SYSTEMS
John J. Metzner and Kenneth C. Morgan May 1967 32 p refs
(Contract AF 19(628)-4321)
(AFCRL-67-0379; TR-400-160; SR-6; AD-660126)

A variable-data-rate procedure employing a fixed word duration is described. The procedure is shown to be compatible with long-code, fail-safe communication. It also permits independent rate variations in the opposing directions of a two-way communication system. By avoiding a weakness which arises when the rates of the two channels are required either to remain fixed or to track each other—namely, that the rate at which information is accepted is controlled by the weaker of the two links—a substantial improvement in overall communication efficiency can be achieved. The advantages of independent rate variation are illustrated. For an assumption of identical but independent Rayleigh-distributed slow fading over the two channels, the independent rate-variation procedure shows a 3:1 advantage in average rate over a fixed, ideal, cumulative decision system and a 2:1 advantage over a variable-data-rate system in which the rate must be the same in both directions. Another model is shown where the advantage is even greater. Author (TAB)

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N68-11933*# Pittsburgh Univ., Pa. Space Research Coordination Center.
A METHOD OF RECOGNITION OF HAND DRAWN LINE PATTERNS
M. J. Zobrak and T. W. Sze 22 Nov. 1967 8 p refs Proc. of the 1st Ann. Princeton Conf. on Inform. Sci. and Systems, 1967
(Grant NsG-416)
(NASA-CR-91072; SRCC-59) CFSTI: HC $3.00/MF $0.65 CSCL 09B

A method utilizing the direction of pen motion during sequential increments of time is presented as a means of recognizing hand drawn line patterns. During the time a pattern is drawn, d+1 discrete points are measured. From these, d quantized directions are obtained and used as parameters in a discriminant function. The coefficients, or weights, of the function are determined through a learning algorithm. Experiments were performed using ten different sets of children's writing. The complete English Alphabet, in capital letters, and the numerals comprised each set. These patterns had various degrees of distortion, rotation, and continuity. After a training phase in which all ten sets were used, the error during recognition was 6.0%. Author

N68-12043# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
DESIGN AND IMPLEMENTATION OF FLIP, A LISP FORMAT DIRECTED LIST PROCESSOR
Warren Teitelman 15 Jul. 1967 118 p refs
(Contract AF 19(628)-5065; ARPA Order 627)
(SR-10; AFCRL-67-0514; AD-660548)

The paper discusses some of the considerations involved in designing and implementing a pattern matching or COMIT feature inside of LISP. The programming language FLIP is presented here as a paradigm for such a feature. The design and implementation of FLIP discussed below emphasizes compact notation and efficiency of operation. In addition, FLIP is a modular language and can be readily extended and generalized to include features found in other pattern driven languages such as CONVERT and SNOBOL. This makes it extremely versatile. The development of this paper proceeds from abstract considerations to specific details. The syntax and semantics of FLIP are presented first, followed by a discussion of the implementation with especial attention devoted to techniques used for reducing the number of conses required as well as improving search strategy. Finally FLIP is treated as a working system and viewed from the users standpoint. Here we present some of the additions and extensions to FLIP that have evolved out of almost two years of experimentation. These transform it from a notational system into a practical and useful programming system. Author (TAB)

N68-12060# Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering.
LIST PROCESSING RESEARCH TECHNIQUES Quarterly Report, 15 Dec. 1966–14 Apr. 1967
J. W. Carr, III, and H. J. Gray Sep. 1967 120 p refs
(Contract DA-28-043-AMC-02377(E))
(ECOM-02377-3; Rept.-68-03; QR-3; AD-661076)

This is the third report of an investigation on the formal characteristics and feasibility of the potential and utilization of push-down type computer memories. List processing language development in this study concerns the refinement of the SPRINT language, an experimental, hopefully useful, and simple list processing language. Work has continued on the Growing Machine, a context-free definitional structure, and its development is considered to be a test-bed for list-processing development. Progress has been made in the following areas: (1) New Software, (2) Applications of List Memories, and (3) Applications of SPRINT and the Growing Machine. TAB

N68-12069# Mitre Corp., Bedford, Mass.
EVALUATION OF ADAM: AN ADVANCED DATA MANAGEMENT SYSTEM
Robert A. J. Gildea Aug. 1967 68 p refs
(Contract AF 19(628)-5165)
(MTR-442; ESD-TR-67-130; AD-661273)

The report evaluates the ADAM project (Advanced Data Management System), its products, applications, and some of its activities, which were part of a larger project entitled Information Systems Tools and Software Techniques. The knowledge and conclusions contained herein are intended for Air Force and other personnel who either are systems programmers or have had a brief technical orientation in information processing systems, and are interested in the management and production of software tools. There are detailed evaluations of documentation and debugging facilities, system languages and language manipulators, data structures and memory allocators. Both the design and implementation of parts of the system, as well as the entire system are discussed. Author (TAB)

N68-12108# RAND Corp., Santa Monica, Calif.
SOVIET CYBERNETICS: RECENT NEWS ITEMS NUMBER 9
Wade B. Holland, ed. Oct. 1967 96 p
(P-3600/9; AD-660834)

Contents: Brief items; Glushkov report on computer design automation; Nairi-2 computer announced (photograph); Computer usage in Ukraine: statistics, evaluation criteria; Heuristics as a science; Survey of Ukrainian automation levels, goals; USSRs commitment to research: personnel statistics; Ukrainian computer and instrument industries: historical survey; Avrora computer designed by M-20; ODRA-1013 Polish computer (photograph); Science in Latvia: personnel statistics; I. E. Strazdin: Latvian mathematician; VINITI evaluation of data handling problems; Press review, September 1967. TAB

N68-12147# RAND Corp., Santa Monica, Calif.
A SURVEY OF SOVIET WORK IN THE THEORY OF COMPUTER PROGRAMMING
Robert A. DiPaola Oct. 1967 144 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5424-PR; AD-661266)

The report is a critical survey of Soviet efforts to develop a mathematical theory of computer programming and automatic programming methods (PP or programming programs). The study traces the development of the operator theory of A. A. Lyapunov and his associates from its starting point in program schemes designed to represent specific problem-solving algorithms to its algebraic formulation in terms of the theory of categories. Other authors have attempted to adapt graph theory and the theory of algorithms to the construction of better programming languages. In contrast to FORTRAN, the practical result of PP has been to raise, rather than lower, the level of technical knowledge required for programming. Current Soviet research is directed toward adaptation and extension of ALGOL 60 rather than further theoretical work. Some of the Russian work, however, may be of practical relevance, particularly Glebovs synthesis of operators from measurably simpler ones. TAB

N68-12195# Army Electronic Labs., Fort Monmouth, N. J.
AN EXTENDED HOLLAND MACHINE SYSTEM
Robert M. Dunn Aug. 1967 17 p refs
(ECOM-2871; AD-661080)

A narrative discussion of a distributed control, multiple processor concept is presented. A possible evolution of the system organization is traced beginning with the Holland machine. A previous independent application-oriented derivation of the concept is cited. Comments on the relative significance of the derivations are offered. The discussion concludes that the proposed system organizational concept outweighs all others which are currently known and which are subject to the same constraints. Author (TAB)

N68-12267# Stanford Research Inst., Menlo Park, Calif.
GRAPHICAL-DATA-PROCESSING RESEARCH STUDY AND EXPERIMENTAL INVESTIGATION Quarterly Report, 1 Jun.–31 Aug. 1967
Peter E. Hart and John H. Munson Sep. 1967 42 p
(Contract DA-28-043-AMC-01901(E))
(ECOM-01901-28; QR-6; Rept.-28; AD-661309)

The report describes the continuing development of scanning, preprocessing, character-classification, and context-analysis techniques for hand-printed text, such as computer coding sheets in the FORTRAN language. The performance of topological feature extraction, combined with character classification by a learning machine, is described, and compared with the performance of other combinations. By performing intra-author testing (gathering the training data and test data from the same author), we have achieved a dramatic reduction in test error rate, to less than 10 percent on a limited sample. We describe an experiment in which a fragment of FORTRAN text is scanned, pre-processed, classified character by character, and subjected to context analysis to greatly reduce the recognition-error rate. Finally, we discuss advances in the method of analyzing arithmetic expressions, a key aspect of the context analysis. Author (TAB)

N68-12331# Chicago Univ., Ill. Inst. for Computer Research.
ICR QUARTERLY REPORT
Victor H. Yngve 1 Feb. 1967 121 p refs
(Contract AT(11-1)-614)
(COO-614-52; QR-12) CFSTI: HC $3.00/MF $0.65

The discussion includes Maniac III engineering activity, the Man-Machine Project, file-handling, input–output, and monitoring procedures for use with the SNOBEL language, an approach to formal semantics, an experimental method for testing numerical stability in initial value problems, and a class of simple combinatoric patterns of automorphisms equivalent to Veblen–Wedderburn planes, and a lower bound for the number of independent complete sets of mutually orthogonal Latin squares. Also force correlations in finite gravitational systems, approximation–solvability of nonlinear equations, and a mode of computer-aided instruction are covered. NSA

N68-12337# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SPECIAL-PURPOSE COMPUTER FOR STATISTICAL STUDIES [SPETSIALIZIROVANNOYE VYCHISLITEL'NOYE USTROYSTVO DLYA STATISTICHESKIKH ISSLEDOVANIY]

A. N. Domaratskiy, V. P. Vorontsov, V. A. Dovgiy, L. N. Ivanov, and Ye. N. Karyshev 16 Jun. 1967 15 p refs Transl. into ENGLISH from the book "Elektricheskiy Metody Avtomaticheskogo Kontrolya" Novosibirsk, Akad. Nauk SSSR, 1964 p 94–102
(FTD-MT-67-23; AD-660963)

The article describes the development of a special-purpose computer for statistical studies with the following requirements: (1) It must possess high accuracy and great high speed operation, which will allow considering it a standard statistical measuring informational system; (2) It must have a universal input device, allowing the input of data (registered in graphic form on tapes of various width), the execution of direct data input without preliminary registration, and, finally, the execution of recording and subsequent data input on a magnetic tape; (3) It must determine statistical characteristics of certain classes of nonstationary random processes; and (4) It must determine not only auto- and mutual-correlation functions, but also mathematical expectations and spectral densities. The first computer will be of the form of a laboratory computer occupying an area of about 2 sq m and, being an experimental model, has four binary digits. TAB

N68-12365# Sandia Corp., Livermore, Calif.
USERS' GUIDE TO DAPT (DIGITIZED APT)
H. Quock Jun. 1967 50 p refs
(Contract AT(29-1)-789)
(SCL-DR-67-53) CFSTI: HC $3.00/MF $0.65

The use of DAPT, which is a Fortran program that generates an APT (Automatically Programmed Tools) part program from a deck of punched cards produced by a coordinate digitizer is explained. An example problem is included. Author (NSA)

N68-12395# Oregon State Univ., Corvallis. Computer Center.
EVALUATION OF THREE CONTENT-ADDRESSABLE MEMORY SYSTEMS USING GLASS DELAY LINES Interim Report, 1 Jan.–1 Jul. 1967
Peter T. Rux 13 Jul. 1967 71 p refs
(Contract Nonr-1286(11))
(CC-67-9; AD-660792)

Evaluation is made of three content-addressable (associative) digital memory system organizations using a circulating memory. Specific reference is made to glass delay-line memories since they offer the best solution to high-speed circulating storage. The memory designs are each developed as a possible memory addition to the NEBULA Computer at Oregon State University. A useful command set is established along with a discussion of applications of such a memory system. Then the three separate data organizations are explained and the logical design and hardware requirements for each system type are detailed and compared. A circulating memory is utilized because it allows very inexpensive implementation of content-addressing capability. Author (TAB)

N68-12398# RAND Corp., Santa Monica, Calif.
DIGITAL COMPUTER SIMULATION: STATISTICAL CONSIDERATIONS
George S. Fishman and Philip J. Kiviat Nov. 1967 39 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5387-PR; AD-660953)

The report discusses the statistical problems that arise in computer simulation experiments. Three problem areas inherent in all stochastic system simulation models are discussed: verification, which determines whether a model actually behaves as an experimenter assumes it does; validation, which tests whether the model reasonably approximates a real system; and problem analysis, which seeks to ensure proper execution of a simulation and proper handling of its results. The study traces the elements of a simulation experiment from initial conception to analysis of final results, defining the statistical problems that arise at each step and relating them to the formal body of statistical theory. Since the aim is to promote awareness of problems, not to solve them, the study offers no general solutions but provides references germane to the statistical problems described. Author (TAB)

N68-12401# Argonne National Lab., Ill. Applied Mathematics Div.
MACRO-FORTRAN, A FACILITY FOR PROGRAMMER-DEFINED MACRO-INSTRUCTIONS IN FORTRAN PROGRAMS
George A. Robinson Jun. 1967 39 p
(Contract W-31-109-ENG-38)
(ANL-7309) CFSTI: HC $3.00/MF $0.65

The language MACRO-FORTRAN, which enables the programmer to write specifications for generating sequences of FORTRAN statements and incorporate these sequences into his FORTRAN program in a natural fashion, is described. The MACRO-FORTRAN translator is written in 3600 FORTRAN. NSA

N68-12435# California Univ., Livermore. Lawrence Radiation Lab.
DOCUMENTATION OF A CONVERSION OF GECENT III FOR USE WITH CDCAPT 3
W. J. Knauff and H. Quock Jun. 1967 59 p refs
(Contract AT(29-1)-789)
(SCL-CR-67-179)

A documentation of computer program statement changes necessary to operate GENCENT III on a CDC 3600 or CDC 3800 as a postprocessor to CDCAPT3 is presented. Author (NSA)

N68-12459# RAND Corp., Santa Monica, Calif.
EXPERIMENTS WITH A POWERFUL PARSER
Martin Kay Oct. 1967 33 p
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5452-PR; AD-660551)

A description is given of a sophisticated computer program for the syntactic analysis of natural languages. The study discusses the notation used to write rules and the extent to which these rules can be made to state the same linguistic facts as a transformational grammar. Whereas most existing programs apply context-free phrase-structure grammars, this new program can analyze sentences with context-sensitive grammars and with grammars of a class very similar to transformational grammars. The program, which is written for the IBM 7040/44 computer, is nondeterministic: The various interpretations of an ambiguous sentence are all worked on simultaneously; at no stage does the program develop one interpretation rather than another. If two interpretations differ only in some small part of a partial syntactic structure, then only one complete structure is stored with two versions of the ambiguous part. The unambiguous portion is worked on only once for both interpretations. Although the current version of the program is written in ALGOL, with very little regard for efficiency, the basic algorithm is inherently much more efficient than any of its competitors. Author (TAB)

N68-12491# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PUNCHED-TAPE DATA INPUT UNIT WITH CIRCUITAL CONVERSION OF NUMBERS [USTROYSTVO VVODA INFORMATSII S PERFOLENTY SO SKHEMNYM PREOBRAZOVANIYEM CHISEL]
Yu. A. Makhmudov and N. B. Bakir-Zade 21 Apr. 1967 15 p refs Transl. into ENGLISH from Vopr. Vychislitel'noy Mat. i Vychislitel'noy Tekhn. (USSR), v. 3, 1965 p 161–170
(FTD-HT-66-795; AD-660730)

The article describes an input device developed for entering information from punched tape in the working storage of a special-purpose computer and providing circuit decimal-to-binary conversion. The device employs series-produced ferrite-diode magnetic elements. Numbers are recorded on the punched tape in the code of the ST-35 apparatus. The conversion scheme is based on

an algorithm using a table of constants. The conversion represents the serial addition of multiple constants. There is an intermediate converter from the ST-35 code to binary decimal code. The article gives a block diagram of the input device, as well as a detailed description of its basic circuit. The circuit speed permits the entry of 1,000 bits (rows) per second, which makes it possible to use it with the photoelectric method of punched tape reading. 156 elements are used to construct the device, including 64 logical and 92 simple elements. Author (TAB)

N68-12505# Bettis Atomic Power Lab., Pittsburgh, Pa.
EXPERIENCES IN PRODUCING A MODULAR COMPUTER PROGRAM
H. Bohl, Jr. and O. J. Marlowe Jan. 1967 19 p refs Presented at Westinghouse Software Symp., Pittsburgh
(Contract AT(11-1)-GEN-14)
(WAPD-T-1975; CONF-670205-1) CFSTI: HC$3.00/MF$0.65

Development of the modular computer program, PAX, was influenced by the past history of the individual programs which made up the modules, by the need to make it useful even before completion, by its inherent size and complexity, by the impending computer replacement, and by the need for communication in the areas of documentation and training. Author (NSA)

N68-12557 Aeronautical Research Council (Gt. Brit.)
AN ANALOGUE COMPUTER FOR ON-LINE CORRECTION OF WIND-TUNNEL FORCE AND MOMENT DATA
B. E. Pecover London HMSO 1967 48 p refs Supersedes RAE-TR-66318; ARC-28858
(ARC-CP-946; RAE-TR-66318; ARC-28858) CFSTI: $3.00

A description is given of equipment using analogue computing techniques for the on-line correction of wind tunnel force and moment data, derived from strain-gauge indicator servos operating with a supersonic wind tunnel. This equipment has enabled a new method of balance calibration to be employed which considerably reduces the possibilities of error and is quicker than previous methods. Accuracy is discussed and comparisons made between results obtained from the new equipment and those obtained by earlier, digital techniques. Author

N68-12591# Rice Univ., Houston, Tex. Dept. of Electrical Engineering.
ENGLISH SPOKEN DIGIT DATA SAMPLER
H. L. Resnikoff and G. A. Sitton Jun. 1967 160 p refs
(Contract AT(40-1)-2572)
(ORO-2572-13) CFSTI: HC$3.00/MF$0.65

An English spoken digit sampler which is a primary data reference volume designed to illustrate the physical and linguistic properties of the English spoken digits O(/O/), 1, 2, 3, 4, 5, 6, 7, 8, and 9 is described. The data is exhibited in a form that allows both visual inspection and quantitative analysis, with emphasis on the latter aspect. NSA

N68-12693# RAND Corp., Santa Monica, Calif.
JOSS LANGUAGE
G. E. Bryan and J. W. Smith Aug. 1967 33 p
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5377-PR/1; AD-661259)

This is a JOSS users portfolio containing three brief reference summaries of the actions that can be requested of JOSS and of the language for requesting these actions. The summaries are presented in varying formats to suit the users convenience: a pocket-size book for personal use (Pocket Precis, 17 pp.), a larger and more complete piece for desk-top or console use (Apercu and Precis, 23 pp.), and a poster-size summary for the bulletin board (Poster Precis, 1 p.). The precis demonstrate that the language provided for JOSS is terse, unambiguous, and readable, stressing familiar English terminology and punctuation and use. The speed and ease of interaction between JOSS and the user, the simplicity of the language, the use of familiar decimal arithmetic, and JOSSs precise error and status reporting combine to allow most problems to be solved by an understanding of the problem at hand and a list of JOSS commands and functions. TAB

N68-12780# Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering.
DESCRIPTION OF EASY ENGLISH
Harvey Cautin and Fredericka Rapp Apr. 1967 110 p
(Contract AF 49(638)-1421)
(Rept.-67-22; AD-660569)

Easy English is a simple command language designed to simplify dialogues between man and machine through a remote typewriter console. It is made up of readily recognized sentences of the English language, sentences which any layman might be expected to use in everyday requests for services or articles from a familiar source. Easy English was developed as a command language for retrieval of documents from a computerized data base. It is intended for all information systems using remote typewriter consoles in a conversational mode. The purpose of the Easy English program is to recognize and execute a command expressed by an English sentence. The program presented enables a user to employ the system using the natural language, English. Author (TAB)

N68-12781# Air Force Cambridge Research Labs., Bedford, Mass.
SELECTED PROGRAMS FOR MANUALLY OPERATED ELECTRONIC DESK CALCULATORS. PART 1: THEORETICAL BACKGROUND AND APPLICATIONS
Kurt H. Haase Jun. 1967 56 p refs *Its* Phys. and Math. Sci. Res. Papers No. 331
(AFCRL-67-0392, Pt. 1; AD-660561)

Many problems of numerical analysis can be solved with the aid of modern electronic desk calculating machines in a competitive time, with minimum effort and high reliability, provided that the work to be performed is well organized. For the particular use of the Friden 132 Electronic Calculator, this paper presents Programs for the manual machine operation and Forms to be used for the written record of the computations. A series of problems, mainly concerned with polynomial operations, has been selected. The paper consists of two separately bound parts. Part I contains the theoretical background, references, and 27 completed examples. Part II contains the Programs for the manual machine operations and record forms. Author (TAB)

N68-12795# Air Force Cambridge Research Labs., Bedford, Mass. Data Sciences Lab.
SELECTED PROGRAMS FOR MANUALLY OPERATED ELECTRONIC DESK CALCULATORS. PART 2: PROGRAM MANUAL
Kurt H. Haase Jun. 1967 71 p *Its* Phys. and Mathematical Sci. Res. Papers No. 332
(AFCRL-67-0393; AD-660564)

Many problems of numerical analysis can be solved with the aid of modern electronic desk calculating machines in a competitive time, with minimum effort and high reliability, provided that the work to be performed is well organized. For the particular use of the Friden 132 Electronic Calculator, this paper presents Programs for the manual machine operation and Forms to be used for the written record of the computations. A series of problems, mainly concerned with polynomial operations, has been selected. The paper consists of two separately bound parts. Part I contains the theoretical background, references, and 27 completed examples. Part II contains the Programs for the manual machine operations and record forms. Author (TAB)

N68-12801 Royal Aircraft Establishment, Farnborough (England).
DIGITAL MAGNETIC TAPE UNITS FOR THE MERCURY AND DEUCE COMPUTERS. PART 1: GENERAL CHARACTERISTICS AND OPERATION
K. Sanderson Apr. 1967 41 p refs
(RAE-TR-67081, Pt. 1)

The description is given in general, i.e. nontechnical terms, the intention being to provide a meaningful introduction for both the ordinary, nontechnical user, and for the digital systems analyst–designer. The treatment covers the outline characteristics and operation of the tape transport, basic aspects of the recording and playback processes, and detailed accounts of recording and playback operation. Operating procedures and interface specifications are covered. Author

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N68-11953# Navy Underwater Sound Reference Lab., Orlando, Fla.
THE MEASUREMENT OF IMPEDANCE AT HIGH POWER Interim Report
R. E. Ford and C. W. Stoops 27 Oct. 1967 28 p
(NRL-6631; AD-661230)

A method and the electronic equipment for applying it was developed to enable the impedance of a transducer or other device, linear or nonlinear, to be calculated from measurements made while the device is operating at high power, pulsed or c-w. The method involves the use of a null-balance technique by which the current and voltage of a c-w reference signal are compared with samples of the unknown signal and nulled against the unknown on an oscilloscope. The relative phase also is measured. Toroidal transformers provide the means of extracting samples from the high driving voltage and current. The electronic components are of solid-state circuitry throughout. Author (TAB)

N68-11979# Texas Instruments, Inc., Dallas. Semiconductor-Components Div.
HETEROCRYSTAL INTEGRATED CIRCUIT TECHNIQUES Quarterly Report, Mar. 1–May 31, 1967
E. Clayton Teague, Stacy B. Watelski, C. Dennis, and L. Sharif Oct. 1967 22 p refs
(Contract DA-28-043-AMC-02029(E))
(Rept.-03-67-66; ECOM-02029-5; QR-5; AD-661042)

The report contains a summary of experimental work related to the following topics: (1) Use of aluminum oxide, silicon oxide, and silicon nitride as possible masking materials for selectively etching GaAs and Ge deposition in GaAs; (2) Isolation properties of GaAs sub SI as received from crystal processing and after oxide and germanium growth; (3) Device characteristics of junctions formed in germanium regions selectively grown in germanium and in gallium arsenide substrates. Author (TAB)

N68-12005# Zenith Radio Research Corp., Menlo Park, Calif.
TRANSVERSE-WAVE HIGH-POWER TUBE Quarterly Report, 1 Apr.–30 Jun. 1967
C. Burton Crumly and Roy A. Larsen Oct. 1967 13 p
(Contract DAAB07-67-C-0226)
(ECOM-0226-2; QR-2; AD-661072)

Research and development work is described on a traveling-wave power amplifier tube employing transverse-wave interaction between the negative synchronous wave and a circuit wave on a balanced structure. The theoretical advantage in this arrangement is the possibility of high-power amplification with high overall efficiency, due to the lack of longitudinal or transverse velocity modulation in the spent beam. Design corrections are discussed and the present status of the first tube is described. Preliminary X-band design considerations are also discussed. Author (TAB)

N68-12062# International Business Machines Corp., Owego, N. Y. Electronics Systems Center.
GALLIUM–PHOSPHIDE LIGHT-EMITTING DIODE ARRAY Quarterly Report, 1 May–31 Jul. 1967
Henry C. Farrell and Robert J. Lynch Oct. 1967 32 p
(Contract DAAB07-67-C-0407)
(IBM-67-928-71; ECOM-0407-1; QR-1; AD-661092)

The object of the research is the design and fabrication of a versatile experimental display module incorporating an array of 60 gallium-phosphide diodes as light-emitting elements. This effort includes the associated control circuitry for accessing, latching, and providing the necessary input waveforms and impulses for X-grid and Y-grid access. This report covers the work accomplished towards the development of an experimental display module using red-light-emitting gallium-phosphide diodes. Both analog and digital X - Y scanning circuits were breadboard tested. Techniques for measuring the light output and for selecting diodes for high-density arrays were also developed. Author (TAB)

N68-12092# Electro Connective Systems, Inc., Brockton, Mass.
THE HARNESS SYSTEMS APPROACH TO FLAT WIRING
R. F. Cobban [1967] 23 p
(AD-660956)

Although flat conductor cable has been available for several years, has many obvious functional advantages, and has been considered to have a huge market potential, penetration into electronics systems to date has not been significant. To a large extent, this is attributable to the lack of adequate termination means. A harness system approach to the solution of this problem is described, wherein the cable and its termination are designed to be predeterminably compatible with each other. Manufacture of both the cable and its termination is discussed, as are the features and functional versatility of the system. Also described is a field connector for flat conductor cable, which is interchangeable with the harness system termination, for application where a factory-manufactured harness is not practicable to round out the total system approach. Author (TAB)

N68-12093# General Precision, Inc., Glendale, Calif. Librascope Group.
A REVIEW OF CERAMIC THIN FILM TECHNOLOGY Technical Report, May 1966–May 1967
Milo Macha Wright-Patterson AFB, Ohio AF Mater. Lab. Oct. 1967 147 p refs
(Contract AF 33(615)-5188)
(AFML-TR-67-226; AD-660590)

The report comprises a detailed description of the materials, techniques and problems in each of the three major areas of thin film applications--dielectrics, magnetics and semiconductors. Included in the report are also basic theories necessary for a complete understanding of the physical and chemical processes related to the areas of interest. Theoretical analysis leads to a description of the critical physical, chemical and structural requirements of films for

device applications. The state of the art of all aspects of ceramic thin film technology is critically reviewed, and recommendations are suggested to overcome existing limitations. Author (TAB)

N68-12127# Army Electronics Labs., Fort Monmouth, N. J.
MEASUREMENT OF F_T FOR ANALYZING THE LARGE-SIGNAL RF BEHAVIOR OF POWER TRANSISTORS
Octavius Pitzalis, Jr. Sep. 1967 10 p
(ECOM-2881; AD-661051)

A technique for measuring the f sub T of radio frequency (RF) power transistors over a broad range of operational current and dissipation levels is described. The method employs a pulsed biasing technique to avert thermal damage to the device. Such high current f sub T measurements provide a more meaningful description of the RF performance capability of a power transistor than the low current level f sub T values conventionally measured and quoted on transistor specifications. The potential of the approach is illustrated by a family of constant f sub T contours developed over the full operating voltage-current range of a modern 50 watt - 80 MHz power transistor. Author (TAB)

N68-12178# Schjeldahl (G. T.) Co., Northfield, Minn.
INTERCONNECTION OF FLAT CABLE TO WIRE, FLEXIBLE CIRCUITY, PRINTED CIRCUIT BOARDS AND OTHER FLAT CABLES
Walter A. Gammal, Sr. Nov. 1967 29 p refs
(AD-660889)

The wiring of electronic systems involving printed circuit boards, conventional wiring and flexible circuitry with flat cable is described. Some design and production suggestions are covered and illustrated. The new C-1000 series of connectors is described in detail. Standards for flat cable and connectors are listed together with examples. A number of special cables and cable harness are described and illustrated. Suggestions for designing a flat flexible cable systems are given. Author (TAB)

N68-12221# Polytechnic Inst. of Brooklyn, Farmingdale, N. Y. Dept. of Electrophysics.
WIDE-ANGLE INTERNAL DEFLECTION STRUCTURES OF CATHODE-RAY TUBES Triannual Report, 1 Mar.–30 Jun. 1967
Rudolf G. E. Hutter Oct. 1967 16 p
(Contract DA-28-043-AMC-02449(E))
(PIBMRI-1355.3-67; ECOM-02449-3; AD-661305)

Test results are described which were obtained with a test gun comprising two two-dimensional lenses and one rotationally symmetrical lens. Conclusions are drawn concerning the strength of the lens action associated with a deflection system. Three deflection systems are compared as to their focusing properties. Another test gun design is described with which it is expected to demonstrate the deflection defocusing requirements of this contract. Furthermore, a deflection system has been designed to demonstrate the properties described in the Second Triannual Report (AD-654 519) on pages 14-25. Author (TAB)

N68-12261# ARO, Inc., Arnold Air Force Station, Tenn.
A FIFTY-NANOSECOND-RISE-TIME THYRATRON LIGHT SOURCE
R. A. Betz (Tenn. Univ. Space Inst.), F. M. Shofner (Tenn. Univ. Space Inst.), and R. H. Hines Arnold Eng. Develop. Center Nov. 1967 29 p refs
(Contract AF 40(600)-1200)
(AEDC-TR-67-218; AD-661261)

An inexpensive light source was built, using a gas thyratron tube, to evaluate and compare various photomultiplier tubes and associated circuitry. The rise time of the light pulse was found to be less than 50 nsec, thereby enabling high frequency response evaluations to be made. In addition, the pulse repetition rate is readily controllable. The characteristics of the system and the experimental results obtained with this source are presented. Author (TAB)

N68-12312*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
GUIDANCE AND CONTROL RESEARCH
In its Space Programs Sum. No. 37-47, Vol. 3 31 Oct. 1967 p 44–45 refs (See N68-12306 03-30)

A thermal detector based on thin film capacitors capable of approaching the theoretical maximum detectivity at room temperature (2×10 cm/W-s$^{1/2}$) is briefly described. Illustrations are included of outputs from a detector connected in a tuned bridge circuit, with and without incident radiation. C.T.C.

N68-12428# Sandia Corp., Livermore, Calif.
LIGHT-ACTUATED TRIGGER GENERATOR
H. W. Olson May 1967 1 p
(Contract AT(29-1)-789)
(SCL-TN-67-42) CFSTI: HC $3.00/MF $0.65

The trigger generator described provides a trigger pulse to synchronize recording equipment with the position of a mechanical device. Trigger-point repeatability is less than 0.001 inch. The generator can be used with any dc supply of about 40 V and 0.33 A. Author (NSA)

N68-12638# Edgerton, Germeshausen and Grier, Inc., Boston, Mass. Systems Div.
3344 TW OSCILLOSCOPE, LE 13540-1, TYPE OS-31
F. D. Kennedy 30 Sep. 1966 123 p refs
(Contract AT(29-1)-1183)
(EGG-1183-336; B-3422) CFSTI: HC $3.00/MF $0.65

The 3344 traveling-wave oscilloscope which was designed as a wide band indicator for recording high-frequency transient signals that occur in the nanosecond or subnanosecond rise time regions is discussed. Topics included are description and purpose, specifications, operation, operation principles, maintenance and installation. NSA

N68-12647# California Univ., Livermore. Lawrence Radiation Lab.
PULSER FOR ACCELERATOR CATHODE
R. W. Kuenning and S. D. Winter 25 Apr. 1967 23 p
(Contract W-7405-ENG-48)
(UCID-15156) CFSTI: HC $3.00/MF $0.65

The design of a high-speed cathode pulser for the injector for a linear accelerator is discussed. Included topics are choice of tubes, damage prevention, avalanche transistor stage, interstage transformer, transformer core reset, shunt peaking and overdrive, time response calculation, and possible circuit improvements. NSA

N68-12657# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TUNNEL-DIODE SCALARS [PERESCHETNYYE SKHEMY NA TUNNEL'NYKH DIODAKH]
A. S. Sidorov 27 Apr. 1967 18 p refs Transl. into ENGLISH from Poluprovodnikovye Pribory i Ikh Primenenie Sb. Statei (USSR), no. 14, 1965 p 131–142
(FTD-HT-67-38; AD-660763)

The principle of operation and characteristics of two pulse counters using tunnel diodes are described. The first is a three-stage binary counter whose input circuit and interstage coupling circuits consist of monostable multivibrators. For each positive pulse, the multivibrators give out two consecutive pulses of opposite polarity. All the tunnel diodes utilized in the circuit are Soviet-made GaAs diodes carrying the designation 3I30IV. Tests made of an eight-stage counter of the same design showed flawless performance, even at bias voltage variations of 7.0-9.2 v. The maximum counting

frequency never fell below 10 Mc. The eighth stage was activated 30 nsec after the appearance of a signal at the counter input. The second pulse counter uses series-connected tunnel diodes which are switched in succession. The output appears after application of a number of pulses at the input equal to the number of series-connected tunnel diodes. The capacitors at the input are necessary for the formation of slow wavefronts which allow sufficient time for the internal capacitances of the diodes to charge up. A threshold element consisting of an emitter follower with TD sub 4 as the load activates the output pulse. The counter performed satisfactorily at bias voltage variations of 6.5-10 v. The maximum frequency of the counter was 10-12 Mc. Author (TAB)

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N68-11930# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SOLID STATE RESEARCH Quarterly Technical Summary Report, 1 May–31 Jul. 1967
Alan L. McWhorter et al 18 Oct. 1967 67 p refs
(Contract AF 19(628)-5167)
(ESD-TR-67-467; AD-661275)

Contents: Solid state device research (Pb1-xSnxSe photovoltaic detectors, PB1-xSnxSe diode lasers, Isothermal annealing of Pb1-xSnxTe, High power and efficiency in CdSe electron-beam-pumped lasers, Epitaxial gallium arsenide for Gunn effect oscillators, The Gunn effect in n-CdTe, Current runaway and avalanche effects in n-CdTe); Optical techniques and devices (Stability measurements of CO2-N2-He lasers at 10.6 micron wavelength, Continuous operation of a long-lived sealed CO2 laser tube, Infrared heterodyne detection, A 10.6-micron four-port circulator using free carrier rotation in InSb); Materials research (Measurement of trace oxygen and water vapor in inert gases, Growth of CrBr3 single crystals, Polymorphism in Ag2Te at high pressures and temperatures, Characterization and structure of La4Re6O19, Preparation of transparent ferrimagnetic materials, Properties of materials for optically-pumped lasers, Chemical analysis); Physics of solids (Electronic band structure, Magnetism, Laser experiments). TAB

N68-11996# Air Force Cambridge Research Labs., Bedford, Mass. Data Sciences Lab.
THE DESIGN OF A MORE COMPLEX BUILDING BLOCK FOR DIGITAL SYSTEMS Interim Scientific Report
W. Frank King, III and Alfred Giusti Sep. 1967 34 p refs
(AFCRL-67-0516; RP-341; AD-660808)

Design techniques for a complex building block for digital systems are developed in this paper. Of particular interest are building blocks that are applicable to the nonstandard portions of digital systems--for example, the control circuitry of a computer. It is shown that a complex block for these applications must have considerable interconnection internal to the integrated circuit chip and multipurpose or multifunction capabilities. A multipurpose logic block (MLB) is proposed as the complex building block based on these constraints. The block has r signal or data inputs and s control inputs and can realize any one of a set of Boolean functions, depending on how the control inputs are connected. The control inputs can be connected to ground, to the supply voltage, or to signal inputs. An algorithm is presented with which an MLB can be designed to realize a specific number of functions. In one example, an MLB is developed for obtaining certain functions of three variables; the functions are sum, majority, equivalence, NOR, and AND. A working demonstration model is designed and constructed from the example. Author (TAB)

N68-12003# Library of Congress, Washington, D. C. Aerospace Technology Div.
SOVIET STUDIES ON AUTOMATIC CONTROL IN SPACE (1957–1967)
Boris Nikolayevich Petrov and Boris Viktorovich Raushenbakh *In its* Foreign Sci. Bull., Vol. 3, No. 11 Nov. 1967 p 28–40
Presented at 2d JFAC Symp. on Automatic Control in Space, Vienna, 4–8 Sep. 1967 (See N68-12001 03-34)

Diversified means of automatically correcting the flight trajectories of artificial earth satellites, planetary probes, lunar space vehicles, and manned space ships, are discussed. Communications equipment, such as television aboard the space vehicle, antenna signal transmission, relay and logic switching devices, are discussed. Meteorological conditions and other pertinent environmental information needed before correctly reorienting the particular space vehicle, are also discussed. Rocket control elements, and stabilization of the vehicle during vernier engine operation are described. L.S.

N68-12031# Goodyear Aerospace Corp., Akron, Ohio. Avionics and Electronics Research and Development Div.
FURTHER STUDIES ON DISTRIBUTED ADAPTION IN NEUROMIME NETWORKS Final Report, Jun. 1964–May 1967
V. V. Griffith, G. H. Bolen, and W. E. Wuerthele Wright-Patterson AFB, Ohio AMRL Aug. 1967 154 p refs
(Contract AF 33(615)-1891)
(GER-13243; AMRL-TR-67-121; AD-660848)

This report describes investigations of networks with adaptive ability distributed through them. It is thought that large-scale adaptive systems can be constructed of adaptive building blocks. These adaptive systems would be flexible in function, reliable and would resist severe damage characteristics of living creatures. Neuron models were tested by interconnecting them into various networks to perform simple control tasks. The test results were evaluated and the evaluation used to improve the theory and the neuron model. The distributed adaption concept was analyzed from an abstract albegraic approach. Using optimal control theory, the combined approach, when studied in depth, contributed to the understanding of the problem, although the conclusions of this report are at best tentative. One conclusion seems reasonably valid: any required adaptive controller can be built using iterative elements provided only that all terminal segments of optimal trajectories of the process are themselves optimal trajectories, and that the process is controllable and observable. Author (TAB)

N68-12076# Edgerton, Germeshausen and Grier, Inc., Bedford, Mass.
NEW SWITCHING CONCEPTS Final Report, 26 May 1964–15 Jan. 1967
J. Thomas, H. Vanden Brink, and D. Turnquist Oct. 1967 84 p refs
(Contract DA-28-043-AMC-00123(E))
(ECOM-00123-F; Rept.-10; AD-661303)

A theoretical and experimental investigation was made into new switching concepts, the objective was to evolve new design concepts for switching high power in pulse modulators. High vacuum and gas discharge devices were both examined in some detail. Digital computer calculations were directed to an outward radial type of electron flow from a curved cylindrical cathode. The optimum electrode configuration determined by the computer calculations indicated that the entire electron beam could be collected at less than 1% of the modulating anode voltage. The experimental radial beam tube did actually provide a means of

producing the desired highly laminar electron flow. In the gaseous discharge switch investigations the emphasis was concentrated on controlling pulse shape and duration through the application of magnetic fields. Although extensive experimentation into the types of fields and methods of application revealed that high power levels and short duration pulses would require prohibitive power levels for the establishment of the magnetic fields, useful applications do suggest themselves. It is recommended that magnetically switched gas discharge tubes be used as switch devices to control high current and/or long pulse in individual pulse applications. Such tubes could also have broad application as series fuse switch devices in high power crowbaring applications. TAB

N68-12090# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

FUNDAMENTALS OF AUTOMATION AND REMOTE CONTROL

S. A. Ginzburg, I. Ya. Lekhtman, and V. S. Malov 23 Mar. 1967 561 p refs Transl. into ENGLISH of the book "Osnovy Avtomatiki i Telemekhaniki" Leningrad, 1965 p 1–505
(FTD-HT-66-356; AD-661002)

The book contains basic information on automation and telemechanical systems. Descriptions are given of electronic, solid-state and other elements (transducers, relays, amplifiers, distributors, regulators, actuator motors et al.). Automatic-control, servomeasuring, and computing systems are discussed. Telemetric and remote-control systems are described. Topics included are: Functions and general characteristics of automation and telemechanical elements, electromechanical elements, ferromagnetic elements, electrothermal elements, electronic and radioactive elements, automatic control systems, systems for remote transmission of angles and servosystems, automatic measuring systems, automatic computing systems, general information on telemetering systems, remote measurement, remote control and remote signaling. TAB

N68-12110# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.

ESTIMATION OF PROBABILITY DENSITY AND DISTRIBUTION FUNCTIONS

R. L. Kashyap and C. C. Blaydon Aug. 1967 18 p refs
(Contract N00014-67-A0226-0004; Grant NSF GK-1970)
(TR-EE67-14; AD-660690)

First and second order stochastic gradient algorithms are developed for suitably approximating the unknown density and distribution functions of a random vector, from a sequence of independent samples. Mean square error criterion and the integral square error criterion are used in the approximations. The rates of convergence and the approximation error are also evaluated. Author (TAB)

N68-12126# New York Univ., N. Y. Dept. of Electrical Engineering.

ANALYSIS AND SYNTHESIS OF NETWORKS USING RESONATORS COMPATIBLE WITH INTEGRATED ELECTRONICS

John O'Neill Jun. 1967 109 p refs
(Contract AF 19(628)-5537)
(AFCRL-67-0472; TR-400-161; SR-7; AD-661269)

The thesis considers the analysis and design of lumped linear networks composed of two-pole subcircuits, or resonators, in various interconnections. The physical systems suitable for building frequency sensitive networks, namely crystals and active RC circuits, lend themselves to characterization as resonators. The crystals do so intrinsically, and the active RC system is convenient for resonators because circuits with more than a pair of poles exhibit excessive sensitivity to parameter variations. The first part of the work examines one-ports or driving point functions, and has a section on synthesis in complex frequency and a section on approximation of a specified real frequency magnitude characteristic. Examples of both types of design are given and discussed. The second part of the work treats two-port transfer functions and, again, is divided into synthesis in complex frequency and approximation in real frequency. The synthesis structure used is an active lattice and offers complete synthesis for functions having no poles at infinity. The approximation system makes use of the same lattice structure and is capable of simultaneous approximation in gain and phase to a specified set of characteristics. Again, examples of both systems are given. A particular active RC resonator design is evaluated for transfer function synthesis, and is found effective. One configuration serves for all parameter combinations, so that the design would serve as a building block for active synthesis. The techniques of this dissertation are sufficient to lead to design of the practical network types having one or two ports. Author (TAB)

N68-12130 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

ON SOLVING THE NON-LINEAR DIFFUSION EQUATION BY MEANS OF AN ELECTRICAL NETWORK [SUR LA RESOLUTION DE L'EQUATION DE LA DIFFUSION EN REGIME NON LINEAIRE A L'AIDE D'UN RESEAU ELECTRIQUE]

M. Enselme and G. Goubert 1967 13 p refs In FRENCH; ENGLISH summary Presented at the 6th Congr. of the Intern. Assoc. for Anal. Calculus, Lausanne, 28 Aug.–2 Sep. 1967
(ONERA-TP-508(1967)) CFSTI: $3.00

An electrical network constituted by self-coils and variable resistances is proposed to solve the diffusion equation when the diffusivity coefficient depends upon the function characterizing the phenomenon studied. Its working principle is described as well as the electrical conditions to be imposed to obtain the solution. The construction of each of the variable resistances and the adjustment of its evolution as a function of the applied voltage at the terminals of each element are exposed. Finally a first verification of the validity of the method is carried out in the one-dimensional case of the wall constituted by a material of variable diffusivity submitted to a heat flux on one of its faces. Author

N68-12138* Pittsburgh Univ., Pa. Space Research Coordination Center.

A TIME-VARYING BOUND ON NONLINEAR SYSTEM TRANSIENT RESPONSE

K. Chinnapareddi and C. C. Li 22 Nov. 1967 9 p refs Proc. of the 1st Ann. Conf. on Inform. Sci. and Systems held in Princeton, N. J., 1967
(Grant NsG-416)
(NASA-CR-91042; SRCC-61) CSCL 09C

For the absolutely stable nonlinear control system described by $\dot{x} = Ax + b\phi(\sigma), \sigma = c'x$, where A is a stable matrix, $\phi(\sigma)$ is a continuous, monotonic nonlinearity satisfying the condition $0 \leq \phi(\sigma)/\sigma \leq k$, a time-varying bound is established for the system transient response due to an initial disturbance $x(0)$. Author

N68-12179*# Texas Univ., Austin. Dept. of Electrical Engineering.

ON THE STABILITY CONSTRAINTS AND OSCILLATORY BEHAVIOR OF COUPLED SYSTEMS

J. K. Aggarwal and H. H. Bybee 1967 12 p refs Presented at the 10th Midwest Symp. on Circuit Theory, Lafayette, Ind., 18–19 May 1967
(Contract NAS8-18120; Grants AF-AFOSR-766-65; NSF GK-261)
(NASA-CR-91108; AFOSR-67-2498; AD-660594) CSCL 09C

Stability constraints have been derived for two general forms of coupled systems of second order nonlinear differential equations. Examples of these systems have been investigated for oscillatory behavior, and general conditions have been derived to assure that their solutions never decay even though the systems have dissipative coupling. Further work is being undertaken on oscillatory behavior

of such systems so as to find a result similar to (**) for higher order systems. The hypersurface computed to find an inner amplitude bound is the first step. Numerical results are not presented.
Author (TAB)

N68-12232# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROBLEMS OF DESIGNING COOLED MIXERS FOR THE SUPERHIGH-FREQUENCY RANGE [VOPROSY SOZDANIYA OKHLAZHDENNYKH SMESITELEY SVCH DIAPAZONA]
V. N. Alfeyev and V. D. Yekimov 28 Apr. 1967 26 p refs Transl. into ENGLISH from Poluprov. Pribory i Ikh Primeneniye, Sbornik Statey (USSR), no. 14, 1965 p 51–71
(FTD-HT-67-375; AD-660729)

The possibility of designing low-noise uhf mixers utilizing the low-temperature properties of semiconductors is discussed. A theoretical analysis was made of the relationship between the basic parameters of cooled mixers and the volt-ampere characteristics of diodes. The effect of low temperatures on both the parameters of mixer diodes and the mixers themselves was investigated experimentally on a stand capable of maintaining diode temperatures from room temperature (300K) to the temperature of liquid nitrogen (77K). On the basis of the results obtained, the following conclusions are made: (1) Cooled mixers based on semiconductor diodes can be used as successive stages in supersensitive receiving systems with quantum mechanical and cooled parametric amplifiers at the input. (2) The cooling of mixers utilizing D403V and D405V diodes reduces the noise factor to 0.6-3 db. (3) In designing cooled mixers with a nosie factor not worse than 5 db, diodes should be used with a transconductance increasing with a drop in temperature (e.g., germanium diodes) or with a high transconductance at very low temperatures (e.g., InSb diodes). TAB

N68-12265# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PHOTOELECTRIC SCANNING DEVICES OF AUTOMATIC SEARCH AND TRACKING, USING METHODS OF ZONAL-ELEMENT SCANNING [FOTOELEKTRICHESKIYE SKANIRUYUSHCHIYE USTROYSTVA AVTOMATICHESKOGO POISKA I SLEZHENIYA, ISPOL'ZUYUSHCHIYE SPOSOB ZONAL'NO ELEMENTNOGO SKANIROVANIYA]
V. A. Strokov 16 Jun. 1967 21 p refs Transl. into ENGLISH of the book "Teoriya i Primeneniye Avtomaticheskikh Sistem", Inst. of Automation and Telemechanics, Nauka, 1964 p 322–330
(FTD-MT-67-68; AD-660952)

Optico-mechanical scanning devices having complicated circuits and using moving parts have energy losses of the radiating object during reflection and refraction and create undesirable torques. Photoelectric scanning devices do not have these deficiencies. The article reports the development of new photoelectric devices of search and tracking which do not have the deficiencies indicated and permit decreasing the read-out time of useful information regarding an object. This is attained by means of optimum scanning of the analyzed field. A device is shown which has a working principle based on the use of an electroluminescent converter consisting of a photoconductor and an electroluminophor. Other devices are discussed, such as, those which are based only on a change of conductivity under the effect of radiation. An example is given. A device in which the analyzed field is projected through a semitransparent mirror onto two sensitive screens located at a right angle to each other is simpler in design. These devices satisfy all the requirements placed on contemporary means of search and tracking. TAB

N68-12283# Naval Weapons Center, China Lake, Calif.
NONLINEAR ESTIMATION TECHNIQUES
S. R. Neal Sep. 1967 30 p refs
(NWC-TP-4420; AD-660640)

A study was conducted in which a least squares criterion was used to solve a discrete, real-time nonlinear estimation problem. The technique centers around the derivation of a sequential algorithm which allows consideration of second-order nonlinearities in system measurements. Alternate nonlinear estimation techniques are discussed, and comparative examples of the various estimation algorithms are presented. Author (TAB)

N68-12334# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE ANALYSIS AND SYNTHESIS OF CONTACTLESS MULTISTROKE CIRCUITS [OB ANALIZE I SINTEZE BESKONTAKTNYKH MNOGOTAKTNYKH SKHEM]
M. Coroi-Nedelcu 16 Jun. 1967 19 p refs Transl. into ENGLISH from the book "Teoriya Konechnykh i Veroyatnostnykh Avtomatov" Moscow, Izd-vo Nauka., 1965 p 199–210
(FTD-MT-66-92; AD-660961)

An algebraic method for the solution of problems of contactless switching circuits is given. The same problem was solved (Gr. C. Moisil. Teoria algebrica a mecanismelor automate. Bucuresti, Editura Tecnica, 1959) for the case of relay-contact switching circuits, by the use of trinary logic. In the problem of indeterminate switching states, due to the small but noticeable effect of time lags in contactless switching (e. g. solid state devices), the exact sequence of switch closures cannot be precisely predetermined, leading to an indeterminate condition known as competition. This condition arises when, in going from state i to state j, two or more variables may be required to change simultaneously, and since the final state is a function of the order in which the switching took place, one may have two or more elements competing for the same time interval in which to switch. To avoid this problem, artificial delays in the form of delay lines are introduced in the circuit so as to prevent two switches closing simultaneously. If it is not physically possible to eliminate this indeterminacy in a given circuit, it is necessary to use suitable transformations to generate a physically different but algebraically equivalent circuit, which must not contain the drop set or lift set networks. A system of recurrent relationships of the type is obtained. TAB

N68-12449# Leeds Univ. (England).
MICROWAVE NETWORKS WITH CONSTANT DELAY
J. O. Scanlan and J. D. Rhodes Griffiss AFB, N. Y. RADC Oct. 1967 31 p refs
(Contract AF 61(052)-925)
(RADC-TR-67-384; AD-660860)

A general class of transfer functions whose delay is constant at all frequencies, and capable of realization by commensurate TEM microwave networks is presented. Examples of this class where the transducer power gain has equiripple behaviour in the passband, the stopband or both are given, and forms suitable for lowpass or bandpass filters, or broadband matching transformers are derived. The synthesis of networks to realize all of these functions is given in terms of closed formulae for the necessary roots. In general microwave Brune, C and D sections are required in the realization. Author (TAB)

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N68-12077# New York Univ., N. Y.
A FACILITY FOR HYPERSONIC FLOW SIMULATION OVER BLUNT-NOSED BODIES Technical Report, Jul.–Dec. 1966
Wing Mak and Victor Zakkay Wright-Patterson AFB, Ohio, ARL Jul. 1967 73 p refs
(Contract AF 33(615)-3236)
(NYU-AA-66-68; ARL-67-0148; AD-660574)

A facility for simulating re-entry flowfields over blunt-nosed bodies is presented. By using an H2O-O2 mixture it is shown that simulation of re-entry flowfields at the stagnation point may be achieved at lower stagnation temperatures. In this manner a large density ratio across the shock may be obtained without significantly altering the chemistry of the air. The criteria for simulation of supersonic flow over blunt-nosed bodies using any gaseous test medium were found to be the dynamic pressure and the density ratio across the normal shock. Combustion gases may be used as an aerodynamic test medium, provided that water vapor condensation is avoided and that equilibrium flow conditions are ensured. In the H2O-O2 mixture family, a mixture of equivalence ratio lambda = 0.2035 has been found to yield density ratios of the order of ten across a normal shock in equilibrium flow by suitably adjusting the pressure level. A buffered shock tunnel test facility is proposed to use the H2O-O2 mixture as the test medium. Flow Mach numbers of the order of ten can be attained at a static temperature of 300K. Operating conditions were determined for the heated air driver, the helium buffer and the H2O-O2 mixture, such that tailored condition of the reflected shock is achieved for maximum testing time. Author (TAB)

N68-12257# Michigan Univ., Ann Arbor. Dept. of Physics.
DEVELOPMENT OF A HEATED SHOCK TUBE Final Report
Yong Wook Kim Oct. 1967 57 p refs
(Grant AF-AFOSR-934-66)
(AFOSR-67-2341; AD-660586)

The construction and operation of a heated shock tube (often called mercury shock tube due to its immediate application) are described in detail. Experimental observations of fluidmechanical interest on shock waves in mercury gas are presented, and discussed in the light of the preliminary theoretical investigation. Author (TAB)

N68-12280# Federal Fire Council, Washington, D. C.
MISSILE SILO FIRE AT LITTLE ROCK AFB, ARKANSAS AND FIRE PROTECTION PROBLEMS FOR SPECIAL ATMOSPHERES INCLUDING OXYGEN
Apr. 1967 41 p Ann. Meeting on Federal Fire Council held in Washington, D. C.
(AD-660933)

The study gives an illustrated talk on the Missile Silo Fire at Little Rock, Arkansas. The report emphasizes the need in fire prevention to properly identify hazards involved in the use of materials and recognize inherently hazardous tasks; shows how hazards for welding are increased in an enclosed space by the presence of hazardous materials; and showed why hazard analysis, application of adequate safety standards, and work scheduling procedures are necessary. TAB

N68-12314*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
AERODYNAMIC FACILITIES
In its Space Programs Sum. No. 37-47, Vol. 3 31 Oct. 1967 p 55–67 refs (See N68-12306 03-30)

Consideration is given to (1) an optical measurement technique for nozzle contour in a 20-inch supersonic wind tunnel, (2) entry dynamics of a spinning vehicle, (3) wake surveys on a free-falling cone, and (4) base heat transfer telemetry. In the first area emphasis is placed on advantages of the technique when performing maintenance, and on advantages that were obtained in resolving minor discrepancies such as those noted during periodic nozzle flow calibrations. In the second area a closed form solution for the angular motion of a spinning body is presented. The validity of this solution is verified through comparisons with exact six-degrees-of-freedom numerical calculations. In the third area emphasis is placed on a technique for obtaining wake surveys on a free-falling cone that was developed in a 20-inch supersonic wind tunnel. In the heat transfer telemetry area consideration is given to the obtainment of support interference-free aerodynamic data in a hypersonic wind tunnel. C.T.C.

N68-12379# Sandia Corp., Livermore, Calif.
THREE-INCH, COLD-GAS SHOCK TUBE
R. A. Thompson Jun. 1967 27 p
(Contract AT(29-1)-789)
(SCL-DR-67-34) CFSTI: HC $3.00/MF $0.65

A three-inch, cold-gas shock tube has been developed and installed at Livermore Laboratory. The facility has the capability of a maximum driver pressure of 10,000 psi using inert gases. The driver section is 4 inches in diameter and 96 inches long. There are two driven sections available: a 3-inch-diameter round section in which a 20,000-psi reflected pressure step can be produced and a 3-1/2-inch square section which is fitted with schlieren photographic windows. Both driven tubes have numerous instrumentation ports. A semiautomatic gas charging system is used to pressurize and fire the facility. Author (NSA)

N68-12389# California Univ., Berkeley. Inst. of Transportation and Traffic Engineering.
PHOTOMETER DETECTION CONTRAST AND VISIBILITY OF RUNWAY LIGHTING IN DENSE FOG Final Report
D. M. Finch, R. Horonjeff, and H. G. Pauls Jun. 1967 77 p refs
(Contract FAA-ARDS-434)
(RD-67-33)

Using a specially developed photometric method, the visibility of a runway lighting system was studied under various conditions of visual range and background brightness. The method is based on measurement of a defined quantity, C_d, called photometer detection contrast, and depends on the correlation of this quantity with subjective visibility. All tests were performed in the FAA Fog Chamber at 1/10 scale. Photometric data for the runway lights were obtained in daytime and nighttime visual ranges of 1200, 900, and 700 ft, and maximum visibility distances for various portions of the lighting system were then determined on the basis of an assumed value of .06 for the minimum usable C_d. Based on the number of lighting elements that would be visible to a pilot under the various test conditions studied, it was concluded that the lighting system would become but marginally effective for visual guidance in a daytime fog of 900-ft visual range and background brightness of about 50–600 fL. The same would hold true for a nighttime fog of 700-ft visual range. In a daytime visual range of 700 ft, the system would no longer provide effective visual guidance. Author

N68-12397# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INJECTOR-TYPE ELECTRON ACCELERATOR WITH CONSTANT WAVE PHASE VELOCITY
V. A. Vishnyakov, I. A. Grishayev, A. I. Zykov, and Ye. K. Ostrovskiy 3 May 1967 15 p Transl. into ENGLISH from the Publ. "Inzhektornyy Uskoritel' Elektronov s Postoyannoy Fazovoy Skorost'yu Volny" Khar'kov, Akad. Nauk Ukr. SSR, no. 1, 1963 p 1–12
(FTD-HT-67-1; AD-660737)

A description is given of the design and operating characteristics of a 6Mev electron accelerator which has a constant wave phase velocity near the speed of light and which serves as high-energy waveguide buncher. TAB

N68-12530# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
LOW ENERGY SPUTTERING SYSTEM
A. Rose and H. Broe Oct. 1966 11 p refs
(AAEC/TM-349)

A description is given of a low-energy sputtering system for producing thin films for use as nuclear particle targets. Author (NSA)

N68-12531*# Dunlap and Associates, Inc., Darien, Conn.
DATA CONDITIONING AND DISPLAY FOR APOLLO PRELAUNCH CHECKOUT: TEST MATRIX TECHNIQUE
Enrique Furth, George Grant, and Herbert Smithline Jan. 1967 68 p refs
(Contract NASw-1363)
(NASA-CR-91056; Rept.-675-TM-10; SSD-372) CFSTI: HC $3.00/MF $0.65 CSCL 22D

The Test Matrix technique, described in this report, provides information on the failure sources or modes tested by each test in a checkout routine or program. This technique allows a system test engineer to follow an efficient course of action in the selection of relevant tests and the classification of components as good, failed, suspect, or untested. The present report summarizes the basic matrix operations and describes work on the development of computer software to demonstrate the concept and determine implementation requirements; evaluation of the matrix's utility in enhancing diagnostic performance; and description of potential applications of the technique. Comparative experiments in fault diagnosis (with and without the technique) show a reduction of about 70% in diagnostic errors (false identification of failure sources) and a reduction in the number of tests required for this improved level of diagnosis. The requirements for application of this technique in the Saturn V checkout hardware and software are also considered. Author

N68-12608# United Kingdom Atomic Energy Authority, Harwell (England).
DETERMINATION OF THE SYNCHROCYCLOTRON ACCELERATING VOLTAGE USING THE INTENSITY DEPENDENCE ON THE FREQUENCY MODULATION [OPREDELENIE USKORYAYUSHCHEGO NAPRYUZHENIYA V SINKHROTSIKLOTRONE S ISPOL'ZOVANIEM ZAVISIMOSTI INTENSIVNOSTI OT CHASTOTY MODULYATSII]
A. N. Safonov Sep. 1966 10 p refs Transl. into ENGLISH from Russian Report JINR-P-2730
(NP-TR-1585; JINR-P-2730)

A method is described for determination of the accelerating voltage on the synchrocyclotron dee under the operating conditions using the intensity dependence on the frequency modulation. The accelerating voltage in dependence on the direct voltage applied to the anode oscillator tubes is given for the JINR synchrocyclotron. Author (NSA)

N68-12768 Kernforschungszentrum, Karlsruhe (West Germany).
THE α, β, γ LABORATORY OF THE EUROPEAN INSTITUTE FOR TRANSURANIUM ELEMENTS [LE LABORATOIRE α, β, γ DE L'INSTITUT EUROPEEN DES TRANSURANIENS]
M. Coquerelle Brussels EURATOM Nov. 1967 52 p
(EUR-3619.f)

In this report we describe the set of experimental devices developed at the alpha-beta-gamma laboratory of the European Institute for Transuranium Elements, Karlsruhe, for the purpose of effecting remote-controlled physical measurements on irradiated plutonium fuels. The main items of this equipment are a metallographic and a microscopic installation, instruments for technological measurements, such as metrology, gamma-scanning, density, volumetric determination of the release for the fission gases, and a microsampling device. Author

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N68-11925# National Physical Lab., Teddington (England). Aerodynamics Div.
CONDITIONS FOR THE EXISTENCE OF AN INERTIAL SUBRANGE IN TURBULENT FLOW
P. Bradshaw 6 Jan. 1967 16 p refs
(NPL-AERO-1220; ARC-28664; AD-660617)

It is found experimentally that the value of K1 in the spectrum formula phi(k sub 1) = K1 epsilon to the 2/3 power k sub 1 to the -5/3 power is constant down to a microscale Reynolds number Re sub lambda of about 100, both in homogeneous turbulence and in shear flow: this value of Re sub lambda is much less than that usually predicted. The result is reconciled with Kolmogorovs theory: it can be used to derive dissipation from medium-frequency spectra at moderate laboratory Reynolds numbers. Author (TAB)

N68-11957# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
DETERMINATION OF THE PARAMETERS OF A SUPERSONIC GAS JET INCIDENT ON AN INCLINED PLANE OBSTACLE [OPREDELENIE PARAMETROV SVERKHZVUKOVOLI GAZOVOI STRUI, DEISTVUYUSHCHEI NA NAKLONNUYU PLOSKUYU PREGRADU]
Yu. M. Rudov and V. N. Uskov Dec. 1967 15 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (Moscow), v. 12, no. 5, May 1967
(TR-45)

The results of a theoretical and experimental investigation of the interaction of a supersonic gas jet, issuing from a conical nozzle, with an inclined plane obstacle are stated. Calculations of the function for the determination of the boundary of the flow spreading over the obstacle and the gas dynamic parameters are obtained. The results of the calculation are corroborated by experiment. Author

N68-11966# General Dynamics/Convair, San Diego, Calif.
NUMERICAL CALCULATION OF THE LOW REYNOLDS NUMBER FLOW OVER A BLUNT WEDGE WITH REARWARD FACING STEP Final Report, Jun. 1966-Jun. 1967
F. S. Freudiger, W. H. Gallaher, and H. U. Thommen Wright-Patterson AFB, Ohio ARL Jul. 1967 140 p refs
(Contract AF 33(615)-3989)
(GDC-DBE-67-012; ARL-67-0151; AD-660575)

A computer program to calculate the low-Reynolds number flow over a wedge with a rearward facing step is described. The numerical method used is based on the approximation of the full Navier-Stokes equations by finite differences. The method is based on a new modification of the Lax-Wendroff difference scheme. A curvilinear, orthogonal coordinate system is used. The basic approach to the problem is to solve for the steady state boundary value problem by treating it as a time dependent initial value problem. Author (TAB)

N68-11972# Naval Ship Research and Development Center, Washington, D. C. Hydromechanics Lab.
EXPERIMENTAL PERFORMANCE OF A CONTROLLABLE-PITCH SUPER CAVITATING PROPELLER Final Report
Richard Hecker, C. Shields, and N. McDonald Aug. 1967 219 p refs
(NSRDC-1636; AD-661219)

Studies were made of cavitation performance and open-water characteristics of a controllable-pitch supercavitating propeller with two, three, and four blades. It was found that in varying the number of blades and pitch ratios the performance followed the trends of conventional propeller designs. By means of several numerical examples, the feasibility of using a controllable-pitch supercavitating propeller is demonstrated. A practical application to a hydrofoil boat is also presented. Author (TAB)

N68-11976# Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering.

THE CALCULATION OF THE LENGTH SCALE OF TURBULENCE IN SOME TURBULENT BOUNDARY LAYERS REMOTE FROM WALLS

D. B. Spalding Sep. 1967 24 p refs

(TWF/TN/31) CFSTI: HC $3.00/MF $0.65

Use is made of Rotta's differential equation for the rate of change of the length scale of turbulence; it is shown that this equation, together with the Kolmogorov–Prandtl model of turbulence, explains why many free turbulent flows spread out with the same angle, and why the associated values of the Prandtl mixing length differ appreciably from one geometry to another. Discrepancies between predictions and experimental results are of the order of 10%; since the analysis is conducted by way of integral equations, with profile assumptions, the agreement is regarded as satisfactory. Some order-of-magnitude estimates are made for the values of the four empirical constants which enter the relations. Author

N68-12037 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

VIRIAL AND VISCOSITY EFFECTS ON THE MEASUREMENT OF MASS FLOW RATES BY MEANS OF A SONIC THROAT VIRIAL EFFECT ON NOZZLE THRUST [EFFET SUR LA VISCOSITE ET EFFET VIRIEL SUR LA MESURE DES DEBITS PAR COL SONIQUE-EFFET VIRIEL SUR UNE TUYERE PROPULSIVE]

Bernard Masure 1967 15 p refs Presented at the 28th Reunion of the Supersonic Tunnel Assoc., Denver, Sep.–Oct. 1967

(ONERA-TP-528(1967)) CFSTI: $3.00

Three correction factors to the law deduced from the one-dimensional theory applied to perfect gas of constant specific heats are used in the formulation. These factors are analyzed in the case of sonic throats of revolution of circular arc profile and supplied with air: curvature effect of the sonic line, viscosity effect assuming a turbulent boundary-layer, and virial effect. The virial effect is also considered from the point of view of the nozzle thrust. The numerical results are correlated to give the corrections to be applied to the standard formulas valid for a perfect gas = 1.4. Author

N68-12096# National Physical Lab., Teddington (England). Aerodynamics Div.

THE RESPONSE OF A CONSTANT-PRESSURE TURBULENT BOUNDARY LAYER TO THE SUDDEN APPLICATION OF AN ADVERSE PRESSURE GRADIENT

P. Bradshaw 6 Jan. 1967 50 p refs

(NPL-Aero-1219; AD-660619)

Mean velocity, turbulent intensity and shear stress were measured in a turbulent boundary layer which passes from a region of constant free-stream velocity U sub 1 to a region with U sub 1 varies as x to the -0.255 power. Further measurements and calculations were made for a range of initial boundary layer thicknesses. Author (TAB)

N68-12098# Aerospace Corp., El Segundo, Calif.

EFFECT OF INCOMPLETE ENERGY ACCOMMODATION ON FREE-MOLECULE RECOVERY TEMPERATURE

Melvin Epstein Sep. 1967 36 p refs

(Contract F04695-67-C-0158)

(TR-0158(3240-20)-1; SAMSO-TR-67-18; AD-660633)

A model of the wall boundary condition in kinetic theory is described and applied to the analysis of the recovery temperature of a circular cylinder placed transverse to a free-molecule stream. This model, more sophisticated than its predecessor, is constructed to allow the description of the non-monotonic variation of thermal accommodation coefficient with gas energy which has been predicted by elaborate theoretical investigations and has been observed experimentally. The model is found to fit all of the available recent experimental data for thermal accommodation coefficients for rare gases on tungsten. The use of this model to predict free-molecule recovery temperatures reveals a pronounced effect of incomplete accommodation on the relationship between recovery temperature and flow Mach number. This has important implications regarding the interpretation of flow field measurements made with a free-molecule recovery temperature probe. Author (TAB)

N68-12102# ARO, Inc., Arnold Air Force Station, Tenn.

SIMILARITY OF A PROBLEM IN CONCENTRATION-DEPENDENT DIFFUSION AND FLOW IN A FREE BOUNDARY LAYER Final Report, May–Jul. 1967

C. E. Willbanks Arnold Eng. Develop. Center Nov. 1967 14 p refs Submitted for publication

(Contract AF 40(600)-1200)

(AEDC-TR-67-200; AD-661260)

The mathematical similarity of a problem in one-dimensional diffusion in a semi-infinite medium when the diffusion coefficient varies linearly with concentration to the problem of the fully developed boundary layer between two fluid streams was demonstrated. By applying the von Mises transformation in reverse, the one-dimensional diffusion equation was transformed to the Prandtl boundary-layer equations, which were subsequently transformed to a single non-linear ordinary differential equation. The transformed boundary and initial conditions of the diffusion problem were shown to correspond to the boundary conditions for the mixing of two uniform fluid streams. Numerical results for the diffusion problem were obtained from existing solutions to the fluid mechanics problem. Author (TAB)

N68-12132 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

RESEARCH ON FLOW SEPARATIONS IN PROPULSION NOZZLES [RECHERCHES SUR LES DECOLLEMENTS DANS LES TUYERES PROPULSIVES]

Pierre Carriere 1967 23 p refs In FRENCH; ENGLISH summary Presented at the Symp. on Coanda Effect—Inst. of Fluid Mech. "Traian Vuia", Bucarest, 22–25 Jun. 1967

(ONERA-TP-506(1967)) CFSTI: $3.00

The analysis of free separation for a uniform two-dimensional flow, is generalized and extended to a nonuniform, axisymmetric upstream flow. The theory assures a good correlation of the measurements made in a family of nozzles and in an accelerated two-dimensional flow. Author

N68-12133 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

A CONTRIBUTION TO THE STUDY OF A SONIC FLOW PAST A BODY [CONTRIBUTION A L'ETUDE DE L'ECOULEMENT SONIQUE AUTOUR D'UN OBSTACLE]

D. Euvrard 1967 15 p refs In FRENCH; ENGLISH summary Presented at the 8th Symp. on Fluid Dyn., Tarda, 18–23 Sep. 1967

(ONERA-TP-519(1967)) CFSTI: $3.00

The behavior of a sonic flow far from a body is considered with the formal but consistant assumption of an inviscid fluid. The gas is assumed to be ideal with constant specific heats. For the region ahead of the shock waves, an asymptotic expansion for the

velocity potential, which is valid in any direction, is found. For the region behind the shock waves, the velocity vector for large values of lateral coordinate is expanded; the first terms obtained derive from potentials, some of them being related to drag and lift. In the wake a new expansion is introduced, and its first term exhibits a nonzero vorticity, and two expansions are matched. The study was performed for plane airfoils. Author

N68-12146 Southampton Univ. (England). Dept. of Aeronautics and Astronautics.
RECOMBINATION OF SHOCK-DISSOCIATED GASES: THEORETICAL AND EXPERIMENTAL ASSESSMENT FOR THE HYDROGEN–OXYGEN-DILUENT SYSTEM
A. Gay and N. H. Pratt Jun. 1967 90 p Sponsored by Min. of Technol.
(AASU-270) CFSTI: $3.00

A theoretical and experimental assessment for shock tube measurements of recombination rates in the hydrogen–oxygen-diluent system is reported. Calculations have been performed to examine the feasibility of using an existing 5-inch diameter shock tube, which permits the steady double Prandtl–Meyer expansion of the dissociated gas. The results indicate that satisfactory conditions can be obtained with some modification to the facility. These modifications have been completed. Experimental investigations of the gasdynamic flow characteristics in the shock tube facility have confirmed the theoretical predictions for the range of conditions investigated so far. Instrumentation for following the reaction process by monitoring OH radical concentrations has been designed and built. This equipment has been tested by experiments in a 2-inch diameter glass shock tube. The results obtained in shock-heated hydrogen–oxygen–argon gas mixtures agree well with results reported by other workers. Author

N68-12172# Sandia Corp., Livermore, Calif.
THERMOCHEMICAL FLOW PROGRAM (TCFP)
A. Emery May 1967 98 p refs
(Contract AT(29-1)-789)
(SCL-DR-66-75)

A general program for computing gas-flow properties for several typical problems (such as shock waves) is described. The program is composed of a series of subroutines which generate thermodynamic data, determine allowable chemical species, compute equilibrium compositions, and calculate flow-state properties. All calculations are based on the assumption of ideal gases and chemical equilibrium. Author (NSA)

N68-12198# Royal Aircraft Establishment, Farnborough (England).
NOZZLE FLOW INTO A VACUUM
M. J. W. Gage Jan. 1967 23 p refs
(RAE-TR-67016; AD-661180)

Details are given of the numerical procedures required for the calculation of the flow from a supersonic axi-symmetric nozzle into a vacuum. The streamlines and density contours of the flow are computed. Author (TAB)

N68-12241# Naval Weapons Lab., Dahlgren, Va.
ANALYSIS OF THE WAVE SYSTEM PROPAGATED INTO A CONICAL SHOCK TUBE FROM THE OPEN END Technical Report, Jan.–Apr. 1967
Jon J. Yagla and Leon P. Anderson 3 Nov. 1967 41 p refs
(NWL-2121; AD-661242)

The method of characteristics was applied to compute the flow properties of the wave reflected from the open end of a conical shock tube. It was found that the resultant rarefaction wave is followed by a compression wave sufficiently strong to form a shock wave which travels back up the shock tube. The details of the rarefaction process were determined and the locus of the shock was plotted in the time-distance plane. The shocks strength and the properties of the subsequent flow were computed. Author (TAB)

N68-12275 Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Mulheim an der Ruhr (West Germany). Institut fuer Festigkeit.
ON THE INFLUENCE OF A SPHERICAL INTERMEDIATE BASE ON FUEL OSCILLATIONS IN SPHERICAL CONTAINERS [UEBER DEN EINFLUSS EINES KUGELFOERMIGEN ZWISCHENBODENS AUF DIE TREIBSTOFFSCHWINGUNGEN IN KUGELBEHAELTERN]
Klaus Schiffner [1967] 36 p refs In GERMAN Presented at WGLR Meeting, Karlsruhe, West Germany, 1967
CFSTI: $3.00

Motion equations for fluid oscillations in rotating symmetrical containers are developed and applied to the sloshing analysis in a sphere with a centered interior fuel tank. Obtained values are then used to calculate liquid motion in the oxidation vessel for the third stage of the ELDO-A rocket; theoretical parameters of the substitute system showed good agreement with experimental results. Transl. by G.G.

N68-12295# National Physical Lab., Teddington (England). Aerodynamics Div.
THE INFLUENCE OF SHOCK AND BOUNDARY LAYER INTERACTION ON SHOCK TUBE FLOWS
L. Davis and J. L. Wilson 4 May 1967 26 p refs
(NPL-AERO-1228; AD-660620)

During the last decade the study of the interaction between normal shocks and boundary layers in the shock tube has been carried out by many research workers. This interest has been fostered by the requirement to understand the effects that this phenomenon may have on the flow properties in the region between the reflected shock and the end of the tube. This so-called reflected shock region is important in chemical kinetics studies and as a reservoir of gas for hypersonic shock tunnels. In the paper a detailed review is given of the various analyses of the problem together with the results of experimental studies. Reflected and transmitted shock bifurcation, the rate of growth of the bifurcated foot, and the effects of transition to turbulence are discussed. The influence of bifurcation on the flow in the shock tube is assessed, especially as a mechanism for transporting cold driver gas to the end plate, causing early cooling of the gas in the reflected shock region. Author (TAB)

N68-12349 Commissariat a l'Energie Atomique, Paris (France).
REFRACTION OF A SHOCK WAVE [REFRACTION D'UNE ONDE DE CHOC]
R. Laharrague, J. Morvan, and J. Thouvenin 15 Sep. 1967 5 p refs In FRENCH Presented at Symp. High Dyn. Pressure, Paris, 11–15 Sep. 1967

Refraction of a plane shock wave that occurs at the interface between aluminum and copper blocks is studied; and it is shown that the angles of incidence of the refraction follows Descartes law for relatively large angles. Experimental results are in agreement with those obtained by classical theory, and an explanation is proposed for the case of small angles of incidence. The speed of the shock does not depend upon the slope of the interface as shown by the incident waves. This is considered important because the index of refraction cannot always be considered as a shock parameter. The indices of refraction for two known solids, on the other hand, permit the determination of the intensity of incident shock and serve as a gauge for shock. Transl. by M.W.R.

N68-12364# Sandia Corp., Livermore, Calif.
FINITE-DIFFERENCE SOLUTION OF THE BOUNDARY-LAYER EQUATIONS
D. R. Chenoweth May 1967 48 p refs
(Contract AT(29-1)-789)
(SCL-DR-67-32) CFSTI: HC $3.00/MF $0.65

A general computer program was developed to analyze steady boundary layers in compressible, multicomponent, and chemically reacting flows. Both molecular and turbulent transport are included.

with the turbulent eddy coefficients left somewhat arbitrary due to the lack of dependable models. The boundary-layer equations, transformed by means of the Howarth–Dorodnitsyn transformation, are solved using the Crank–Nicolson finite-difference procedure and the tridiagonal algorithm. Author (NSA)

N68-12448# Maryland Univ., College Park. Dept. of Aerospace Engineering.
THE NUMERICAL SOLUTION OF BOUNDARY LAYER PROBLEMS
Stephen C. Lubard and Joseph A. Schetz Sep. 1967 25 p refs
(Grant AF-AFOSR-1228-67)
(AFOSR-67-2046; AERO-Rept.-67-1) CFSTI: HC $3.00/MF $0.65

An approach to the numerical solution of the steady boundary layer equations is presented. The technique is developed in detail for incompressible, laminar problems; the extension to compressible and/or turbulent flow is straightforward. Normal derivatives are approximated by finite differences yielding a nonlinear system of ordinary differential equations which is integrated in the streamwise direction starting from an initial velocity profile. The method is applicable to arbitrary choices of the initial profile, the pressure gradient and/or the injection or suction distribution. The classical Howarth Problem and the boundary layer on a circular cylinder are solved as test cases; velocity profiles, skin friction and the separation point are all predicted accurately. The solution for a flat plate with constant injection is then presented and compared with previous approximate results. As a final example, flow around a porous circular cylinder with various rates of injection is treated. Author

N68-12555# National Physical Lab., Teddington (England). Aerodynamics Div.
THE EFFECT OF INITIAL CONDITIONS ON THE DEVELOPMENT OF TURBULENT BOUNDARY LAYERS
P. Bradshaw and D. H. Ferriss 3 Feb. 1967 40 p refs
(NPL-AERO-1223; ARC-28771; AD-660621)

Calculations by a method that is believed to be reasonably accurate were made to demonstrate how perturbations decay, in zero pressure gradient, until all that remains is a change in boundary layer thickness. Initial perturbations in typical aerofoil pressure gradients can usually be represented by an equivalent change in initial boundary layer thickness, which produces percentage changes of the same order of magnitude in distance to separation. Author (TAB)

N68-12650# North American Rockwell Corp., Anaheim, Calif.
THE DAMPING OF TURBULENT FLOW BY LONG-CHAIN MOLECULES
E. R. van Driest Sep. 1967 19 p refs
(Contract AF 49(638)-1442)
(C7-2535/020; AFOSR-67-2369; AD-660883)

The paper develops the fundamental idea that velocity fluctuations in turbulent flow near a wall are damped by viscous interaction with a grid of long-chain molecules, thus attenuating the Reynolds stresses and thereby reducing drag. Formulas are derived which relate pipe friction factor with Reynolds number, additive concentration, and a length which is characteristic of the particular additive used. The theory accounts for the essential features of experimental data on velocity profile and friction drag obtained by Elata, Lehrer, and Kahanovitz for guar gum and Ernst for carboxymethylcellulose. The analysis also admits turbulence reduction not only by macromolecules in solution, but also by foreign matter in mixture so long as they move with, or are entrained by, the fluid. Author (TAB)

N68-12671# Oak Ridge National Lab., Tenn.
VARIATION OF SHOCK OVERPRESSURE WITH DISTANCE IN AN EXPLOSIVELY DRIVEN SHOCK TUBE
Lawrence Dresner 12 Sep. 1967 49 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1966) CFSTI: HC $3.00/MF $0.65

Variations of shock overpressure with distance down a shock tube were calculated for the following two methods of driving a shock tube: rapid smokeless powder burning in a closed driver section confined with a breakable membrane, and detonation of an explosive gas mixture confined by a breakable membrane. Results were compared with results found by detonating a small amount of high explosive at one end of a tube far down the tube, variations of shock overpressure of the three methods were indistinguishable if the total energy is the same in all methods. Near the end of the driver tube, shock produced by rapid burning smokeless powder and detonation of a gas explosive is unusual. This behavior was analyzed and shown to be due to propagation of rarefaction waves through the gas behind the shock front. Numerical calculations explaining the flow process are discussed. NSA

N68-12800 Royal Aircraft Establishment, Farnborough (England).
ON THE INFLUENCE OF THE ADDITION OF HEAT TO HYPERSONIC FLOW [UEBER DEN EINFLUSS DER WAERMEZUFUHR BEI HYPERSCHALLSTROEMUNGEN]
J. Zierep Apr. 1967 23 p refs Transl. into ENGLISH from Acta Mech., v. 2, no. 2, 1966 p 217–230
(RAE-LIB-TRANS-1222) CFSTI: $3.00

The following problem is investigated: how much heat has to be added to a hypersonic field in order to produce a non-negligible influence on the flow. It turns out that the Tsien parameter may be used as a measure. In the case considered shock equations and equations of motion are written in reduced form. They contain a new similarity law which permits comparison of different hypersonic fields with different heat addition. Statements concerning the drag increase of a profile due to addition of heat are made. Author

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N68-11943*# Arizona Univ., Tucson. Geochronology Dept.
BIBLIOGRAPHY OF CHEMICAL PRODUCTS OF VOLCANISM
Paul Pushkar and Paul E. Damon [1967] 84 p refs
(Grant NGR-03-002-076)
(NASA-CR-91073) CFSTI: HC $3.00/MF $0.65 CSCL 08D

The bibliography covers literature concerning 1) Volcanic gases and sublimates, gases contained in rocks, and related matters, 2) Nongaseous chemical products of terrestrial volcanism, 3) Gas contents of meteorites, lunar volcanism, and related subjects, and 4) General references dealing with terrestrial volcanism. L.S.

N68-11951*# Miami Univ., Coral Gables, Fla. Inst. of Molecular Evolution.
RESEARCH RELATING TO LUNAR STUDIES Semiannual Report, Mar. 1–Aug. 31, 1967
31 Aug. 1967 19 p
(Grant NGR-10-007-044)
(NASA-CR-91040) CFSTI: $3.00 CSCL 08D

Amino acid compositions of extracted hydrolyzates from volcanic samples were analyzed. A possible mechanism by which

hydrogen cyanide may have built up to amino acids in prebiological rock is outlined. Syntheses of optically active alpha amino acids from alpha keto acids by reductive amination, by the Strecker method, and by prototropy in a metal complex of Schiff base composed of alpha amino and alpha keto acids, are described. Organic chemical studies of the carbonaceous constituents of meteorites are discussed; and the organic geochemistry of molecules of biological significance in coals, are considered. Distribution patterns of elements within carbonaceous meteorites are compared with those in terrestrial hydrothermal deposits. L.S.

N68-11970# Environmental Science Services Administration, Boulder, Colo. Inst. for Environmental Research.
HEIGHT GAIN, LOCATION GAIN, AND CORRELATION IN IRREGULAR TERRAIN AT 20, 50, AND 100 MHZ
A. P. Barsis and M. J. Miles Apr. 1967 71 p refs
(ITSA-35; IER-35; PB-174840) CFSTI: HC $3.00/MF $0.65

Further results on height gain, location gain, and correlation are presented which are based on data obtained from a comprehensive measurement program in irregular terrain at frequencies of 20, 50, and 100 MHz. Specifically, it was found that height gain, but not location gain, is independent of path distance for transmission paths up to 80 km long. Location gain is defined as the reduction in transmission loss obtainable by a search within a 100-m radius of a nominal receiving point. The measurement program permitted simulation of the interaction between net and relay type communication links by simultaneous recordings of signals received from a test station with low transmitting antenna height, and a commercial frequency modulation broadcast station (not co-located) with a high transmitting antenna. It was found that the correlation coefficient between transmission loss values from the two sources is close to unity when the transmission paths have a small angular separation, but decreases with increasing angle between transmission paths. Author

N68-11988# Pennsylvania State Univ., University Park. Dept. of Electrical Engineering.
IONOSPHERIC D-REGION ELECTRON DENSITIES AND COLLISION FREQUENCIES DURING THE QUIET SUN PERIOD MEASURED BY MEANS OF RADIO WAVE INTERACTION, PART 2 Scientific Report, 1 Jul.–31 Dec. 1964
A. J. Ferraro and H. S. Lee 15 Nov. 1967 22 p refs
(Grants NSF GP-4622; NSF GP-846)
(SR-312(D))

Electron density and collision frequency profiles are presented of the D-region obtained during the IQSY Program with a radiowave interaction facility. All measurements have been carried out at the Ionosphere Research Laboratory (N. Lat. 40°–47°, W. Long. 77°–57°), University Park, Pennsylvania. Average seasonal and diurnal profiles of electron density are presented along with monthly mean values of collision frequency. Author

N68-12023*# Geological Survey, Washington, D. C.
SEISMIC DETECTION OF NEAR-SURFACE CAVITIES
Joel S. Watkins, Richard H. Godson, and Kenneth Watson GPO 1967 17 p refs Sponsored by NASA *Its* Professional Paper 599-A
(NASA-CR-91049) GPO: $0.20 CSCL 08G

Oscillations with durations of 1 second or more and with narrow frequency bands have been observed over cavities in lava and alluvium at depths ranging from 1 to 14 meters. They are probably primarily radial oscillations of cavity walls, and calculations show that dominant frequencies are generally within a factor of 3 of those computed from M. A. Biot's theoretical results for radial oscillations of a cylindrical hole in an infinite solid. Delays in arrival times and anomalous attenuation of seismic waves traversing cavities have also been observed. Fractured and broken rock in the chimney above a nuclear explosion cavity is thought to be responsible for delays in Rayleigh waves and delays in what are probably trapped waves. Fourier analysis and autocorrelation have been used successfully to detect these and similar resonant phenomena in noisy backgrounds; crosscorrelation of proximate traces was less successful for this purpose. Author

N68-12030*# Southwest Center for Advanced Studies, Dallas, Tex.
RADIANCE AND POLARIZATION OF MULTIPLE SCATTERED LIGHT FROM HAZE AND CLOUDS
George W. Kattawar and Gilbert N. Plass 20 Sep. 1967 44 p refs Sponsored jointly by NASA
(Contract AF 19(628)-5039)
(NASA-CR-91139; AFCRL-67-0570; SR-7; AD-661268) CFSTI: HC $3.00/MF $0.65 CSCL 04A

The radiance and polarization of multiple scattered light is calculated from the Stokes vectors by a Monte Carlo method. The exact scattering matrix for a typical haze and for a cloud whose spherical drops have an average radius of 12 microns is calculated from the Mie theory. The Stokes vector is transformed in a collision by this scattering matrix and the rotation matrix. The two angles which define the photon direction after scattering are chosen by a random process which correctly stimulates the actual distribution functions for both angles. The Monte Carlo results for Rayleigh scattering compare favorably with well known tabulated results. Curves are given of the reflected and transmitted radiances and polarizations for both the haze and cloud models and for several solar angles, optical thicknesses, and surface albedos. The dependence on these various parameters is discussed.
Author (TAB)

N68-12038# Massachusetts Inst. of Tech., Cambridge. Dept. of Meteorology.
ROUND HILL TURBULENCE MEASUREMENTS. VOLUME 1: EXPERIMENTAL TECHNIQUES, DATA-PROCESSING PROCEDURES, AND DATA TABULATIONS FOR RUNS 87A AND 95A
H. E. Cramer, F. A. Record, and J. E. Tillman 1 Dec. 1966 23 p refs
(Contract DA-AMC-28-043-65-G10)
(ECOM-65-G10, V. 1; AD-661033)

The volume describes the experimental techniques and the data-processing procedures employed in a program of turbulent structure measurements carried out at the Round Hill Field Station. It also contains data summaries for 12 of the 76 field experiments selected for inclusion in this report. The field site and the experimental procedures are described in Section I. Sections II and III respectively contain descriptions of the data-acquisition system and the data-processing procedures. Section IV contains data summaries for Runs 87A through 95A; data summaries for the remaining field experiments are presented in Volumes II, III, IV, and V. Author (TAB)

N68-12045# Stanford Univ., Calif. Dept. of Geophysics.
A STUDY OF SHORT PERIOD MICROPULSATIONS Final Report
Robert L. Kovach 30 Sep. 1967 20 p refs
(Contract DA-31-124-ARO(D)-417)
(AROD-6135-4-P; AD-661068)

Geomagnetic micropulsations in the period range of 0.3 to 120 seconds have been recorded on flux-rate variographs at many widespread locations: Palomar, California, since July 1955; Resolute Bay, Canada, since November 1957; Uppsala, Sweden, since July 1958; Reykjavik Iceland since June 1958; and Huancayo, Peru, since October 1958. The flux-rate variographs consist of pickup coils having a turns-area of 750 x 28,000 cm squared connected directly to galvanometers recording photographically with standard seismograph recording drums. Author (TAB)

N68-12056# Massachusetts Ins. of Tech., Cambridge. Dept. of Meteorology.
ROUND HILL TURBULENCE MEASUREMENTS. VOLUME 5: DATA TABULATIONS FOR RUNS 79A THROUGH 85C
H. E. Cramer, F. A. Record, and J. E. Tillman 1 Dec. 1966 307 p refs
(Contract DA-AMC-28-043-65-G10)
(ECOM-65-G10, V. 5; AD-661037)

The volume contains the data summaries for Runs 78A through 85C. Vertical profiles of mean wind speed, air temperature, and soil temperature are presented in Section I. Section I also includes estimates of terms of the heat-budget equation. Turbulence statistics are presented in Section II. For a description of the field experiments and the data-processing procedures, reference should be made to Volume I (AD-661 033) of this series. Author (TAB)

N68-12064*# Southwest Center for Advanced Studies, Dallas, Tex.
CALCULATIONS OF REFLECTED AND TRANSMITTED RADIANCE FOR EARTH'S ATMOSPHERE
Gilbert N. Plass and George W. Kattawar 13 Sep. 1967 32 p refs Sponsored in part by NASA
(Contract AF 19(628)-5039)
(NASA-CR-91228; AFCRL-67-0569; SR-6; AD-661267) CFSTI: HC $3.00/MF $0.65 CSCL 04A

The reflected and transmitted radiance of the earths atmosphere is calculated by Monte Carlo techniques. The exact scattering function for the aerosols is used as calculated from the Mie theory. The aerosol vs. height distributions proposed by Elterman and by Kondratiev et al are compared. The Rayleigh and aerosol scattering events are included in the calculation, as well as the ozone absorption, where appropriate. Results are given at wavelengths of 0.27, 0.3, 0.4, 0.7 and 1.67 microns. The mean optical paths of the reflected and transmitted photons, the flux at the lower boundary, and the planetary albedo are tabulated. TAB

N68-12070# Norwegian Defence Research Establishment, Kjeller.
EXPERIMENTAL STUDIES OF THE ARCTIC D-REGION Final Scientific Report
Bjorn Landmark 30 Jan. 1967 26 p refs
(Contract AF 61(052)-599)
(AFCRL-67-0282; E-100; AD-660555)

The first part of this report deals with results from propagation experiments for measurements of the density and collision frequency of the free electrons during conditions of auroral absorption. The results obtained during a flight on 26 June 1966 are discussed in some detail. Results from RF impedance probe measurements of electron density and temperature are then discussed, and finally measurements of primary electrons by a Geiger-Muller tube experiment are given. Author (TAB)

N68-12083*# California Univ., Berkeley. Space Sciences Lab.
CHEMICAL EVOLUTION
Melvin Calvin *In its* Ann. Conf. of Episcopal Cathedral Deans Apr. 1967 p 14–24 (See N68-12081 03-34)

An overview is presented on the search for the record of chemical organizations along the path of the evolutionary process. The geologic history of the earth is depicted in summary form, with the period of chemical evolution indicated as having started at a stage in the physical development of the earth which puts it into essentially the same form as it has today. Several broad classes of organic compounds are considered, and figures are included to show different molecular structures. Summary data, obtained from analyzing rocks of various geologic ages, are presented. M.G.J.

N68-12124 Joint Publications Research Service, Washington, D. C.
SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NUMBER 170
18 Dec. 1967 55 p refs
(JPRS-43755; TT-61-11147-170) CFSTI: $3.00

Abstracted data from recent publications are presented in the general areas of astronomy, meteorology, oceanography, terrestrial geophysics, and upper atmosphere and space research. Complete bibliographic information is included. N.E.N.

N68-12251*# Texas Univ., Austin. Electrical Engineering Research Lab.
CLEAR AIR TURBULENCE AND METHODS OF DETECTION Final Report, 1 Apr.–30 Nov. 1966
Nov. 1966 7 p refs
(Grant NGR-44-012-048)
(NASA-CR-91137; P-23) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Abstracted data is presented from recent publications and laboratory reports, emphasizing refractive index spectra and differences. Topics reported include the following: position and distribution of clear air turbulence patches; detection using pulse microwave radar and the expected mean return power; refractive index variations, filter functions, and amplitude distributions; and a radar system for the remote detection and analysis of turbulence; and surface refractivity at 14,500 ft elevation. N.E.N.

N68-12260 Kyoto Univ. (Japan).
STRESS WAVES AND DYNAMIC CHARACTERISTICS OF ROCKS UNDER DETONATOR'S ATTACK
Ichiro Ito and Makoto Terado Sep. 1967 6 p refs Symp. High Dyn. Pressure, Paris, 11–15 Sep. 1967

Stress wave and strain measurements induced in cylindrical rock specimens subjected to impulsive loads from electrical detonations were made using a capacitance gauge. The experimental arrangement is schematically depicted. Examples of the displacement and strain oscillograms, and plots of stress wave shapes for various detonator intensities, distance from shot point, and length of rock sample, are also depicted. Results indicate that a plastic or shock wave seems to be generated in the rock near the shock point. The technique used was found to be simple and convenient. The dynamic compressive and tensile strengths of rock in the study were generally found to be greater than the static strengths. L.S.

N68-12346# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
HEAT TRANSFER AND PERFORMANCE ANALYSIS OF A THERMAL PROBE FOR GLACIERS
Haldor W. C. Aamot Sep. 1967 18 p refs
(CRREL-TR-194; AD-661050)

A thermal probe penetrating a glacier requires heat at the hot point for melting as well as along its entire length to balance the radial heat dissipation in the ice and thus prevent freezing in. The heat transfer problem is solved with a LaPlace transform and the results are developed graphically to simplify the numerical calculations. A performance diagram, developed as a design and operating aid, serves for analysis of the anticipated penetration performance of the probe and the required power levels. Author (TAB)

N68-12385# Massachusetts Inst., of Tech., Cambridge. Dept. of Meteorology.
ROUND HILL TURBULENCE MEASUREMENTS. VOLUME 2: DATA TABULATIONS FOR RUNS 96A THROUGH 104
H. E. Cramer, F. A. Record, and J. E. Tillman 1 Dec. 1966 271 p
(Contract DA-AMC-28-043-65-G10)
(ECOM-65-G10, V. 2; AD-661034)

The volume contains the data summaries for Runs 96A through 104. Vertical profiles of mean wind speed and air temperature are presented in Section I and the turbulence statistics are presented in Section II. For a description of the field experiments and the data processing procedures, reference should be made to Volume I (AD-661 033) of this series. Author (TAB)

N68-12407# Massachusetts Inst. of Tech., Cambridge. Fluid Mechanics Lab.
THEORY OF ION COLLECTION BY A SUPERSONIC SOUNDING ROCKET IN THE D-REGION
Ain A. Sonin Apr. 1967 37 p refs
(Contract Nonr-1841(93))
(Publ.-67-2; AD-660650)

Charged particle collection rates are derived in terms of free stream conditions for a supersonic, blunt-nosed sounding rocket with an electrode at the stagnation point. The analysis applies at altitudes below about 70 km. It is shown that then the electric field at the electrode is sufficiently high to dominate the particle collection, as is possible in practice at the higher altitudes, one obtains an expression for the collection rate which applies to a wide class of rocket geometries and is largely independent of flow effect. Author (TAB)

N68-12483# Weather Bureau, New York.
THE EFFECTS OF DAMS, RESERVOIRS AND LEVEES ON RIVER FORECASTING
Richard M. Greening Sep. 1966 34 p
(W-51; TM-16)

Fundamental hydrological principles, and methods of measuring and predicting natural streamflow, are examined. A diagram of a hypothetical river basin and reservoir system is presented and used as a model for evaluating the effects of the dams, reservoirs, and levees used in the system on the streamflow. The available water sources (principally a lake); available storage; and allocation of storage are factors considered. River constriction factors are also noted. The model is useful in forecasting river flow and conditions (flood control). L.S.

N68-12486# Navy Electronics Lab., San Diego, Calif.
VERTICAL AND HORIZONTAL THERMAL STRUCTURES IN THE SEA
E. C. La Fond and K. G. La Fond 29 Jul. 1966 138 p refs
(NEL-1395; AD-653739) CFSTI: HC$3.00/MF$0.65

The sea temperature structure of the upper layers was investigated by the use of a thermistor chain towed off the southern extremity of Baja California, Mexico, which revealed vertical and horizontal motion, large scale turbulence, and possible Doppler effects. The thermoclines were categorized in four types, smooth, normal, rough, and irregular. The power spectrum of vertical oscillation in the thermocline showed small peaks at wavelengths of 0.3 and 0.7 mile. The slopes of isotherms were determined from a study of over 65,000 data samplings. Author (TAB)

N68-12497# Denver Univ., Colo. Dept. of Physics.
ATMOSPHERIC ABSORPTION OF SOLAR RADIATION BY THE 9.6 μ OZONE BAND
Aharon Goldman, David Murcray, Frank Murcray, and Walter Williams Oct. 1967 26 p refs
(Contract AF 19(628)-5202; ARPA Order 363)
(AFCRL-67-0572; SR-6; AD-661293)

The statistical band model, combined with the Curtis-Godson approximation is applied to the analysis of atmospheric slant path absorption of the 9.6 micron O3 band. The theoretical spectra are compared with experimental absorptions observed during a balloon flight during which spectra were obtained at altitudes up to 30 km. The results are shown to agree with the accuracy of the data. The band model method of calculation is compared to exact line by line calculation and to the combination of the Curtis-Godson approximation and line by line calculation. A surprisingly close agreement is found between the different methods of calculation, confirming the success of the application of the band model method to the data. Author (TAB)

N68-12506# Columbia Univ., Palisades, N. Y. Lamont Geological Observatory.
MIXING, DIFFUSION, AND CIRCULATION RATES IN OCEAN WATERS Annual Progress Report
Jun. 1967 500 p refs
(Contract AT(30-1)-2663)
(CU-2663-8; APR-8) CFSTI: HC$3.00/MF$0.65

A summary of work in the physical oceanography program for 1966 to 1967 is presented. Twenty-three papers on the mixing, diffusion, and circulation rates in ocean waters are also presented. Separate abstracts were prepared for four papers. NSA

N68-12522*# Eastern Air Lines, Inc., Miami, Fla.
ATMOSPHERIC TEMPERATURE GRADIENTS RELATED TO CLEAR AIR TURBULENCE IN THE UPPER TROPOSPHERE AND LOWER STRATOSPHERE
Paul W. Kadlec [1967] 21 p refs
(Contract NAS4-1194)
(NASA-CR-91055) CFSTI: HC$3.00/MF$0.65 CSCL 04A

Clear air turbulence of various intensities, especially at altitudes between 50,000 and 70,000 feet, has been encountered on numerous occasions by the XB-70 airplane flying at supersonic airspeeds. A preliminary review of some of these data indicated that high altitude turbulence was often associated with large vertical gradients in the temperature profile. An earlier study reported correlation between horizontal temperature changes and significant clear air turbulence. An investigation was made to determine whether any specific patterns in the vertical temperature profile were found to be associated with horizontal gradients and/or significant clear air turbulence. Results from the analysis are presented which discuss the relationship of temperature lapse rate, inversions, and upper air features to turbulence. Data from five XB-70 test flights are analyzed in conjunction with information compiled on commercial flights to further explore the temperature/turbulence relationship. Author

N68-12622# Library of Congress, Washington, D. C. Aerospace Technology Div.
FOREIGN SCIENCE BULLETIN, VOLUME 3, NUMBER 12 Monthly Review of Selected Foreign Scientific and Technical Literature
Dec. 1967 61 p refs
CFSTI: $3.00

Radiophysical investigations of the auroral ionosphere are reported, along with a survey of scientific trends in Soviet aviation institutes. Plate theory, shell theory, and polymer mechanics at Moscow University are reviewed; as is the measurement of aerodynamic parameters. A study of radiation stability in silicon semiconductor detectors irradiated with 2.3 MeV protons is summarized; and attention is given to the thermal decomposition of ethylenic and acetylenic glycerols, the Venera-4 space probe, Atlant-1 towed undersea vehicle, and a highly efficient metalloceramic beam tetrode with a power of 150 watts at a frequency of 1000 MHz. A report is presented of the Soviet–French colloquium on energy conversion. M.W.R.

N68-12648# California Univ., Livermore. Lawrence Radiation Lab.
PLOWSHARE PROGRAM, VOLUME 2, NUMBER 8 Quarterly Report, May 1–Jul. 31, 1967
David D. Rabb, comp. 31 Jul. 1967 23 p refs
(Contract W-7405-ENG-48)
(UCRL-50009-67-3) CFSTI: HC$3.00/MF$0.65

The sloop project feasibility study was completed and accepted. The AEC will direct the detonation and Kennecott the longer term copper leaching phase. Several years will be required to complete the safety studies at the Arizona site. Prospects for an early 1969 shot date are optimistic. A code was developed for predicting the extent of cracking produced in brittle materials such as granite,

dolomite, or salt. Gasbuggy studies are proceeding toward a firing date during the second quarter of 1968. Monte Carlo calculations were made to determine the best method of in situ measurements of hydrogen in earth media. Pressure transducers were developed which may be cast in grout. The design of project Bronco for the use of nuclear explosions to break up oil shale deposits for subsequent in situ retorting is discussed. NSA

N68-12776# California Univ., Berkeley. Lawrence Radiation Lab.
RADIOACTIVITY OF UPPER MESOZOIC GRAYWACKES IN THE NORTHERN COAST RANGES, CALIFORNIA
Harold A. Wollenberg, Alan R. Smith, and Edgar H. Bailey 12 Aug. 1966 34 p refs Presented at Geol. Soc. of Am. Meeting, San Francisco, Nov. 1966
(Contract W-7405-ENG-48)
(UCRL-17061; CONF-661118-1) CFSTI: HC$3.00/MF$0.65

Traverses across the Coast Ranges north of San Francisco were made to measure the field gamma radioactivity and to sample graywackes of the Franciscan formation, its Coastal Belt unit and the Great Valley sequence. Specimens were analyzed for U, Th, and K by gamma spectrometry; K-feldspar contents were determined by point-counting stained slabs. The K-feldspar content has little effect on radioactivity or heat production of the rock units. Low K-feldspar content does not indicate low heat generation; therefore, low temperature–high-pressure metamorphism is not related to K-feldspar content. Radioactivity tends to decrease with increasing metamorphic grade. Thorium/uranium ratios fall within the range described by Adams and Weaver (1958) as typical of eugeosynclinal sediments, and are like Th/U ratios in granitic rocks of the Sierra Nevada, the suggested source area. Uranium, Th, and K concentrations of the graywackes are compatible with those of a cratonal source. When the heat-production values are combined with heat-flow measurements now being obtained, the thicknesses of the sedimentary columns and the effect of the rocks' radiogenic heat on the observed geothermal gradient may be calculated.
Author (NSA)

N68-12796# Calif. Univ., La Jolla. Scripps Inst. of Oceanography.
OCEANIC ELECTRIC CURRENTS, GEOMAGNETIC VARIATIONS AND THE DEEP ELECTRICAL CONDUCTIVITY STRUCTURE OF THE OCEAN-CONTINENT TRANSITION OF CENTRAL CALIFORNIA
Jean H. Filloux 30 Jun. 1967 166 p refs Supported in part by Am. Petrol. Inst. and by NSF
(Contract Nonr-2216(23))
(SIO-REF-67-18; AD-657935)

The variations of electromagnetic field components along a line across central California have been examined in the frequency range .125 to 4 cph by means of an array of stations extending from 320 km inland to 630 km offshore. The three components of the magnetic variations were recorded at six land positions. Simultaneously, records of the oceanic electric field in a direction approximately parallel to the coast were obtained at three stations located as far as 150 km offshore by using self-contained recorders installed on the sea floor. The cross-correlation of all field components leads to field relationships suggesting a large-scale, nearly two-dimensional structure of the electrical conductivity of the earths crust and upper mantle in a region adjacent to the California coast. Estimates of the continental and oceanic conductivity distribution with depth were carried out by solving numerical models. The estimate of the offshore conductivity profile based on models of the coastal cross section are in excellent agreement with the independent magnetotelluric sounding. In the light of the present knowledge of the properties of rocks at high pressure and temperature, the high electrical conductivity of the oceanic basement favors a highly basaltic external mantle shell, extending to no less than 30 km below the Mohorovicic discontinuity. Author (TAB)

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N68-11946# Environmental Science Services Administration, Boulder, Colo. Inst. for Environmental Research.
AN ON-LINE DISTRIBUTION ANALYZER AND FADE COUNTER FOR TIME VARYING SIGNALS
Donald V. Glen Apr. 1967 53 p ref
(ITSA-33; IEA-33; PB-174839) CFSTI: HC$3.00/MF$0.65

The report describes a Portable Distribution Analyzer (PDA) designed for automatic or manually controlled analysis of time variant data signals at a field site or in the laboratory, a description of circuit logic, and the use of solid-state devices, such as integrated circuits and transistor circuitry. Operation of the analyzer, for the purpose of obtaining cumulative amplitude distributions and computation of the number of signal fades, is also presented.
Author

N68-11963*# National Bureau of Standards, Washington, D. C. Electronic Instrumentation Div.
LIFE CYCLING TEST ON SEVERAL STRAIN GAGE PRESSURE TRANSDUCERS
Paul S. Lederer Oct. 1967 25 p refs
(NASA Order R-09-022-043)
(NASA-CR-91117; NBS-TN-434) GPO: $0.20 CSCL 14B

This publication reports the effects of many thousands of pressure cycles on the performance characteristics of several types of strain gage pressure transducers. The results obtained indicate permanent changes in zero pressure output and sensitivity. Most of these changes tend to occur during the first few thousands of cycles. The equipment and procedures used to obtain the data are described.
Author

N68-11991# Aerospace Corp., El Segundo, Calif. Aerodynamics and Propulsion Research Lab.
EXPERIMENTAL EVALUATION OF FLUSH ELECTROSTATIC PROBES FOR REENTRY MEASUREMENTS
W. Paul Thompson Jul. 1967 74 p refs
(Contract F04695-67-C-0158)
(TR-0158(3240-20)-4; SAMSO-TR-67-14; AD-660531)

The current collection characteristics of flush-mounted electrostatic probes were determined in a simulated reentry boundary layer flow. The thermochemistry and fluid dynamic profiles on sharp cones at 180 to 100 kft altitude are simulated by a subsonic flow of arc-heated air in a 1/2 x 2 in. cooled channel. The experimentally determined probe currents are correlated with the known channel electron densities using two theoretical models developed by Chung and Bradfeldt et al. It is found that for electron densities of order 10 to the 10th power to 10 to the 13th power Chungs theory correlates the data well. High temperature materials were tested, and stainless steel electrodes in pyrolytic boron nitride insulators are recommended for operation up to surface temperatures of 1400K. Comparison of the two theoretical models in predicting flight performance shows them in excellent agreement for sodium-contaminated ablating cones below 175 kft. For the low electron densities on sharp cones in clean air, neither theory is valid above 115 kft altitude. Detailed graphs and tables of flight environment, materials properties, and probe electrical characteristics are presented.
Author (TAB)

N68-12016# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
THE PHILBERTH PROBE FOR INVESTIGATING POLAR ICE CAPS
Haldor W. C. Aamot Sep. 1967 17 p refs
(CRREL-SR-119; AD-661049)

The Philberth probe is a surface-controlled, nonrecoverable instrumented vehicle that can penetrate polar ice sheets down to 3600 m by melting. It can be used to measure temperature, stress, ice movement, and seismic, acoustic and dielectric properties. It can also be used for other investigations with remote instrumentation. The probe consists of a hot point for melt penetration, instrumentation for control and measurement functions, two supply conductor coils to link the probe with the surface for transmission of power and measurement signals, and a reservoir section. The probe is filled with a dielectric fluid. Author (TAB)

N68-12028# Illinois Univ., Urbana. Coordinated Science Lab.
AN IMPROVED POLARITY COINCIDENCE DETECTOR
W. E. Carr, M. Raether, and R. Trogdon Sep. 1967 28 p ref
(Contract DA-28-043-AMC-00073(E))
(R-367; AD-661291)

A Polarity Coincidence Detector has been constructed with increased sensitivity and sufficient threshold stability to allow integration times in excess of 1,000,000. The system uses sampling at four phase locations, thereby increasing the signal count and shortening the integration time for a given accuracy by eliminating the necessity for measuring the noise separately. The modulation frequency can be varied between 50Hz and 50kHz without adjusting the location of the sampling pulses. Solid state circuitry is used throughout the system. The straight counters are replaced by arithmetic units, resulting in greater dependability. Author (TAB)

N68-12053# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
A PORTABLE GAMMA SPECTROMETER FOR SAFEGUARDS USE
E. M. Sheen, J. I. Forsberg, and C. A. Ratcliffe Sep. 1967 54 p refs
(Contract AT(45-1)-1830)
(BNWL-508) CFSTI: HC $3.00/MF $0.65

A compact portable gamma spectrometer was developed for use by the USAEC Division of International Affairs in safeguarding inventories of ^{235}U contained in nuclear reactor unirradiated fuel elements or in various other sources. General purpose gamma spectrometry is also conveniently carried out using the instrument. Main chassis solid state circuitry, excluding the scintillation probe and preamplifier, comprises a wide-range high voltage supply, double delay line pulse amplifier, split-window gain stabilizer, single channel pulse height analyzer, six decade scaler, automatic timer, count rate meter, low voltage regulators, and a battery charger. Instrument power is supplied by a NiCd rechargeable battery, also located in the main chassis, which provides a maximum of 25 hr continuous operation. All electronic circuits, except the battery charger, are fabricated in plug-in modules. The modular electronics, probe, and probe stand are mounted in two rugged compact fiberglass transit cases. Author (NSA)

N68-12091# Utah Univ., Salt Lake City. Upper Air Research Lab.
TRANSMISSION LINE PARAMETER MEASUREMENTS—STANDING WAVE IMPEDANCE PROBE
John S. Hyatt Aug. 1967 81 p refs
(Contract AF 19(628)-4995)
(UU-67-5; AFCRL-67-0505; SR-9; AD-660907)

Accuracy of information obtained from the standing wave impedance probe is dependent to a great extent on the precision to which the transmission line parameters are known. The purpose of this report is to consolidate and record the significant methods and techniques of parameter measurements of the artificial transmission lines used with the impedance probe. Methods for finding the transmission line constant and typical values are given for propagation of both attenuation and phase constants. Author (TAB)

N68-12139* ITT Industrial Labs., Fort Wayne, Ind.
DESIGN STUDY REPORT FOR INFRARED FILTER WEDGE SPECTROMETER INSTRUMENT FOR NIMBUS D SATELLITE Quarterly Report, 6 Apr.–1 Jul. 1967
D. Juarez, R. A. Harber, J. Sonnek, J. Stark, R. Pownall et al 24 Jul. 1967 222 p refs
(Contract NAS5-10388)
(NASA-CR-91079; ITTIL-67-1034; QR-1) CFSTI: $3.00 CSCL 20F

This report covers the design study of an Infrared Filter Wedge Spectrometer (FWS) Instrument for Nimbus D satellite. The completed study contains basic design approaches, hardware details, and procedures required to carry out the design and construction of the FWS. The testing of the FWS under realistic conditions is described along with specific details of the Bench Checkout Units (BCU). It is concluded that the infrared FWS can be designed and built within the basic constraints as outlined in NASA specification S-623-P3. It is therefore recommended that the program proceed with its next phase, that of construction of the FWS Engineering Model. Author

N68-12239# Army Edgewood Arsenal, Md. Nuclear Defense Lab.
SILICON DIODE FAST NEUTRON DOSIMETER. PHASE 2: ISOCHRONAL AND ISOTHERMAL ANNEALS OF THE RADIATION DAMAGE
J. M. Swartz, W. H. Closser, and M. O. Thurston Oct. 1967 48 p refs
(Contract DA-18-035-AMC-101(A))
(NDL-TR-83-11; AD-661323)

A discussion of the theory of annealing based on diffusion-limited processes is presented, along with the development of the characteristic equations for both monomolecular and bimolecular processes. A development of the theoretical dependence of the annealing characteristics on the chemical impurity concentration is also presented. Isochronal and isothermal anneals of the lifetime and forward voltage of p-i-n diodes, degraded by fast neutron bombardment, were performed over the temperature range from 23C to 200C. The diodes were made from both n- and p-type, pulled and float zone material. Resistivities ranged from 50 to 1000 ohm-cm. The isochronal and isothermal results indicated that there are three dominant defects: one which anneals at room temperature; one which anneals in the 50C to 120C temperature range; and another which starts to anneal above 120C. All defects anneal with second-order kinetics. None of the defects seems to be associated with chemical impurities originally present in the material. Author (TAB)

N68-12286# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SMALL-SIZE 128-CHANNEL PULSE ANALYZER [MALOGABARITNYY 128-KANAL'NYY ANALIZATOR IMPUL'SOV]
I. S. Krasheninnikov, S. S. Kurochkin et al 25 Apr. 1967 38 p refs
Transl. into ENGLISH from Yadernoye Priborostr., Nauchno-Tekhn. Sbornik (Moscow), no. 1, 1964 p 77–100
(FTD-MT-67-04; AD-660962)

The article describes a small pulse analyzer, using a new ferrite data recorder, the block diagram of which is shown. Its main parts are the input unit, the data recorder, the control block, and the data readout blocks. The input unit converts the pulse height into a sequential digital code and does not differ essentially from the standard circuits used for the purpose. The new type of data recorder has three main features which increase its operating

reliability and reduce the volume of the electronic equipment: (1) A single reading winding is used in the sequential access to the number digits, a single amplifier with discriminator, and an arithmetic unit consisting of a single flipflop only. This increases greatly the operating stability. (2) The possibility of using a half-adder consisting of a single flipflop likewise reduces the data-recorder failure probability. (3) The reliability is also increased through the use of a small number of elements for setting the reading and writing currents and through the absence of an inhibiting current. The data recorder provides for the storage of 128 16-digit numbers, and its construction and operations are briefly described. All the other units are described in some detail. A breadboard of the analyzer was tested and the suitability of the equipment for its purpose is demonstrated. The breadboard measured 362 x 350 x 450 mm and weighed approximately 20 kg. The readout time for a single number is approximately 2 sec and for all the numbers is approximately 4 min. If only half of the channels are filled, the circuitry can be modified so as to reduce the readout time to one-half. TAB

N68-12289# Naval Training Device Center, Orlando, Fla. Physical Sciences Lab.

RESOLUTION CRITERIA FOR OPTICAL AND PHOTOGRAPHIC SYSTEMS

Frank Oharek Oct. 1967 26 p refs

(NAVTRADEVCEN-IH-137; AD-660680)

In writing specifications and establishing design goals for optical or photographic training devices, it is necessary that optical resolution criteria be established. Optimum resolution is sometimes not feasible due to system complexity or economic limitations, but a valuable training device may still be produced with degraded resolution. The guidelines for determining acceptable degradation of resolution are presented along with the analysis of a particular system, a periscope view simulator. No general degradation criteria can be established; each system must be analyzed following a procedure similar to the one outlined in this report. Author (TAB)

N68-12290 India. Dept. of Atomic Energy, Bombay.

SETTING UP OF A RECORDING FABRY–PEROT SPECTROMETER (REFPOS)

G. D. Saksena and S. A. Ahmad 1967 25 p refs

(BARC-290) CFSTI: $3.00

Installation procedures and operating results are described for a Fabry–Perot spectrometer used for optical studies of nuclear properties such as nuclear spin, magnetic and quadrupole moments, and for isotopic abundance determination of uranium and other elements. The scanning system, monochromator, interferometer, photomultiplier, and recording assemblies are discussed and examples of spectrometer applications are given. E.C.

N68-12319*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

LUNAR AND PLANETARY INSTRUMENTS

In its Space Programs Sum. No. 37-47, Vol. 3 31 Oct. 1967 p 169–174 (See N68-12306 03-30)

The development of a digital technique to generate single-valued functions of voltage versus time is described. The impetus for this approach evolved from the instrumentation requirement of a mass spectrometer to have provided a hyperbolic sweep voltage that is precisely repeatable and easily controlled. This need, coupled with a state-of-the-art breakthrough in large scale integration of diode matrices, suggested the possibility of generating this sweep voltage digitally. The technique has the advantage of being capable of generating many otherwise difficult, if not impossible, functions. For example, the sweep voltage utilized by the mass spectrometer is exponential. The exponential was chosen because it approximates the hyperbolic function which has data compression properties but would otherwise be very hard to synthesize using standard methods. C.T.C.

N68-12335# School of Aerospace Medicine, Brooks AFB, Tex.

AN IMPROVED ELECTROCHEMICAL CARBON DIOXIDE SENSOR

Robert J. Reyes, Charles F. Martin, and J. Ryan Neville Jul. 1967 18 p refs

(SAM-TR-67-54; AD-660557)

Continued work with an electrochemical carbon dioxide detector has produced a unit that has improved signal stability as well as a considerably shortened response time. The detector configuration incorporates a pH electrode and an Ag-AgCl reference electrode joined by an electrolyte solution composed of tris(hydroxymethyl)aminomethene buffer and including the enzyme carbonic anhydrase as a catalyst. The various factors affecting the response time were investigated and CO2 tension measurements were obtained with a bare glass electrode. Increased electrical stability, as well as simplification of the electronics, was achieved by the incorporation of a field-effect transistor (FET) in the probe assembly of the detector. The conventional high impedance electrometer system normally used with such detectors was replaced and capacitive pickup problems at the input stage of remotely placed signal conditioners were minimized by close physical arrangement of the FET and the detector. Response times of less than 2 seconds for 98% of a step change (14 to 35 mm. Hg PCO2) were obtained. Author (TAB)

N68-12347# Los Alamos Scientific Lab., N. Mex.

AN IMPROVED METHOD FOR CALIBRATING A BEAM-SPLITTER AT HIGH TEMPERATURE

Robert L. Horton 13 Jan. 1967 11 p refs

(Contract W-7405-ENG-36)

(LA-3592)

A device is described which improves the method of calibrating a beam-splitter in the range 2500 to 3000°C. Author (NSA)

N68-12356# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

STANDARDS OF DYNAMOMETERS AND OF BALANCES AT THE MODANE–AVRIEUX RESEARCH CENTER [ETALONNAGE DE DYNAMOMETRES ET DE BALANCES AU CENTRE D'ESSAIS DE MODANE–AVRIEUX]

Maurice Dubois 1967 21 p refs In FRENCH Presented at the MESUCORA Congr., 17–21 Apr. 1967

(ONERA-TP-452(1967) CFSTI: HC $3.00/MF $0.65

General activities with regard to dynamometer and balance standards are used, and some of the difficulties encountered in developing such standards for aerodynamic wind tunnel and propulsion testing are described. An overview is presented of various standards in use. Thermal effects and resulting corrections are discussed, along with mechanical and electrical difficulties. Various installations of dynamometric standards are detailed and illustrated. Transl. by M.W.R.

N68-12374 Central Lab. for Radiological Protection, Warsaw (Poland).

CONVEX-TYPE SILICON DETECTOR [DETEKTOR KRZEMOWY Z POLKULISTA POWIERZCHNIA CZYNNA]

A. Dabrowski and J. Roman 1967 12 p refs

(CLOR-65/D)

A convex-type silicon surface-barrier detector with hemispherical sensitive surface of 4.5 cm^2 was made. It is designed for use in an electrostatic precipitator, as a collecting electrode for direct counting of alpha particles of radon decay products in air. The energy resolution measured at room temperature of about 25°C was better than 1.5% for 6 Mev alpha particles. Author

N68-12406# National Bureau of Standards, Boulder, Colo. Radio Standards Lab.

A SENSITIVE RECORDING NMR ULTRASONIC SPECTROMETER

Lawrence W. James 7 Sep. 1966 16 p refs
(NBS-TN-344) GPO: $0.20

Instrumentation is described for automatically obtaining a continuous recording of ultrasonic absorption lines. Ultrasonic power is added to the crystal lattice by a transducer mounted on a single crystal of the sample. The interaction of the ultrasonics with the nuclear spin system is recorded by using a pulse NMR system in conjunction with a boxcar integrator. This technique is more sensitive and provides more easily interpretable results than earlier systems. Author

N68-12421# IIT Research Inst., Chicago, Ill.
FEASIBILITY OF ISOTOPIC X-RAY SOURCES FOR PORTABLE STRESS ANALYSIS EQUIPMENT
R. A. Semmler Apr. 1967 80 p refs
(Contract AT(11-1)-578)
(COO-578P28-10) CFSTI: HC $3.00/MF $0.65

The feasibility of using a 10 millicurie ^{55}Fe X-ray source for X-ray diffraction is examined. Diffraction lines from iron were measured to within 0.2° using a proportional counter and rudimentary apparatus, but experiments with film were unsuccessful because of the low Mn K_{α} photon output (10^{6}/sec). Further improvement in speed and resolution is possible for general diffraction work but the diffraction angles are poorly situated for stress work. Other source and film characteristics measured in the study include the angular dependence of the radiation, X-ray transmission of the Polaroid XR-7 cassette, Polaroid film sensitivity, and a comparison of intensifier screens. Suggested collimator arrangements to permit using a larger area source with less self-absorption are given. In conjunction with a smaller diffraction camera than used here, it is concluded that the present source would be adequate for a portable diffraction instrument of modest resolution for field work with either pulse counters or film. A film system would be particularly simple and highly portable. Film exposure times producing a weak but definite line would be of the order 10 hours. Author (NSA)

N68-12473# Dow Chemical Co., Golden, Colo. Rocky Flats Div.
A HYDROGEN ISOTOPIC ANALYZER
Charles M. Johnson and John M. Connell 11 Sep. 1967 8 p refs
(Contract AT(29-1)-1106)
(RFP-999)

A simple cryogenic gas chromatograph for the separation and analysis of the isotopes of hydrogen was designed and built. Its unique feature is the immersion of the thermal conductivity detector in liquid nitrogen to increase sensitivity. Author (NSA)

N68-12508# Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant.
INNOVATIONS IN AIR MONITORING TECHNIQUES FOR LARGE-SCALE PROGRAMS
Merwyn Sanders 11 Jan. 1967 24 p refs Presented at the IAEA Symp. on Instr. and Tech. for the Assessment of Airborne Radioactivity in Nucl. Operations, Vienna, 3–7 Jul. 1967
(Contract W-7405-ENG-26)
(Y-KB-78; CONF-670704-1) CFSTI: HC $3.00/MF $0.65

Practical and useful techniques have been developed and used for effective air monitoring in a large scale industry for toxic and radioactive particulates. One of the most successful techniques developed involves the use of Standard Holleran punched cards equipped with a window which holds a filter paper insert. The use of this card permits automation of analysis and machine data processing. Air monitoring by this system offers the following advantages compared to conventional air sampling programs: automation of analyses is provided with particular application to extensive monitoring programs; by combining records and analysis into one unit, the possibility of laboratory errors in recording and reporting results is greatly reduced; commercially available material and computer card handling equipment are utilized; the so called aperture card technique offers practical standardized procedures for collecting samples; costs of air sampling and analysis are reduced compared to conventional air monitoring programs; and the system minimizes data storage and offers easy retrieval for historical reference; statistical comparisons, and legal records.
Author (NSA)

N68-12524# United Kingdom Atomic Energy Authority, Harwell (England).
HIGH RESOLUTION MASS SPECTROMETER WITH MULTI-STAGE FIELDS
Hisashi Matsuda [1967] 16 p refs Transl. into ENGLISH from Shitsuryo Bunseki (Japan), v. 14, Jun. 1966 p 78–81
(NP-TR-1580)

A mass spectrometer which may have very large mass dispersion and resolving power is proposed. It incorporates the tandem combination of n cylindrical electrostatic analyzers of sector type (opposite deflections to each other) with the same a_e, ϕ_e, and magnification X(<1) each, and the tandem combination of n homogeneous magnetic analyzers of sector type (opposite deflections to each other) with the same a_m, ϕ_m, and magnification 1/X each. These two field groups are connected in tandem so that the deflection in the final electric field and that in the first magnetic field are in the same direction. The double focusing condition is satisfied if $a_e = a_m = a$. The total magnification of the image is 1, while the mass dispersion at the final image is given as follows: $D_m = (a/2)[1+(1/X)][1+(1/X)+(1/X^2)+\ldots+(1/X^{n-1})]\gamma$. If X is very small and n large, then very large mass dispersion and resolving power may be expected. For example, in the case X=1/3, n=3, $a_e = a_m = 100$ cm, $\Phi_e = 63°39'$, $\Phi_m = 90°$, mass dispersion of 2600 γ cm and resolving power of 26,000,000/aμ are expected. NSA

N68-12526# Aeroprojects, Inc., West Chester, Pa.
APPLICATIONS OF ULTRASONIC ENERGY: ULTRASONIC INSTRUMENTATION FOR NUCLEAR APPLICATIONS Bimonthly Progress Report, Feb. 1–Mar. 31, 1967
Apr. 1967 8 p refs
(Contract AT(30-1)-3622)
(NYO-3622-8; BMPR-33) CFSTI: HC $3.00/MF $0.65

Plans for installing the ultrasonic incipient boiling detector in a dynamic test loop were discussed. Specifications for a suitable dynamic system were evolved, and detailed designs were prepared. Flow measurements in water as a simulant for molten metal, using the ultrasonic flowmeter, showed a linear relation between transient time as measured by the instrument and flow rate, at rates up to 14–18 gallons per minute. Plans were made for experimental effort to improve operation of the flowmeter. Author (NSA)

N68-12593# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
DIGITAL VOLTMETER READ-OUT SYSTEM TYPE 173
P. J. Ellis Oct. 1966 28 p ref
(AAEC/M-74)

A description is given of a digital voltmeter read-out system developed for use with a square-wave reactivity oscillator for the research reactor MOATA. The functions and operating details are given and typical subunits are described. The system uses standard modular logic cards. Author (NSA)

N68-12648# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
STUDY OF THERMOCOUPLES FOR CONTROL OF HIGH TEMPERATURES [ETUDE DE THERMOCOUPLES POUR LE REPERAGE DES HAUTES TEMPERATURES]
Michel Villamayor (Ph.D. Thesis—Lyon Univ.) 1967 111 p refs In FRENCH
(CEA-R-3182)

Previous works have shown that the tungsten–rhenium alloy thermocouples were a good instrument for control of high

temperatures. The W/W 26% Re and W 5% Re/W 26% Re French manufactured thermocouples and intended for control of temperatures in nuclear reactors up to 2300°C were studied. In out-pile study the general characteristics of these thermocouples: average calibration curves, thermal shocks influence, response times, and alloys allowing the cold source compensation are determined. The evolution of these thermocouples under thermal neutron flux was determined by in-pile study. The observations have led to a proposal of a new type of thermocouple settled of molybdenum–columbium alloys. Author (NSA)

N68-12669*# National Research Corp., Cambridge, Mass.
STUDY OF DENSITY CALIBRATION IN SPACE Final Report, Jun. 29, 1966–Jan. 16, 1967
P. Fowler and F. J. Brock. Washington NASA Dec. 1967 46 p refs
(Contract NAS5-3959)
(NASA-CR-987) CFSTI: HC$3.00/MF$0.65 CSCL 14B

Methods of calibrating ion gauges and mass spectrometers were studied to determine a method for in-flight calibration of detectors installed on spacecraft. The method developed consists of diffusing a known hydrogen flux through the wall of a small diffuser tube into the detector enclosure which produces a pressure increment equal to the ratio of hydrogen flux to exhaust conductance, by raising the temperature of the tube with an internal heater which dissipates a prescribed power for a prescribed time interval. Three successive generations of prototype in-flight calibrators were designed and constructed and evaluated. The results indicate that the diffuser generates a hydrogen flux which is linear over a dynamic range of 3×10^5, that calibration pulse heights are repeatable within ±2.0% and that pulse height variation can be maintained less than 1.0% for 30 seconds. The data indicate that the pressure decay rate, associated with the diffuser, following a calibration pulse is such that after 15 minutes the pressure is no more than several percent of the external pressure if the calibration pulse is no more than an order of magnitude above the external pressure, except for pressures less than 10^{-9} Torr, which require a longer recovery time. Author

N68-12679# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
THE CAL MICROWAVE INTERFEROMETER Final Report
R. J. Myers and F. A. Giori. 1 Jun. 1967 39 p refs
(CAL-157)

The receiver and phase demodulator circuit, the phase lock and output circuit, and the power supply circuits for a microwave interferometer apparatus, are described; and circuit diagrams are depicted. Photographs of interferometer assembly, and a block diagram of the circuit system, are shown. The phase locked, coherent, low powered radar interferometer has logged a total of 200 hrs of operation to date with no serious breakdown or difficulty. Operating instructions are given. Although the interferometer is successfully being used presently for studies in physiological monitoring, the exceptional capabilities of this radar are certain to extend to future studies in other areas requiring a sensitive range measuring instrument. L.S.

N68-12711# Kiel Univ. (West Germany).
A COUNTER TELESCOPE WITH ANALOG COMPUTER FOR MOMENTUM ANALYZING OF μ IN A HIGH ENERGY SPECTROGRAPH [EIN ZAEHLROHRTELESKOP MIT ANALOGRECHNER ZUR IMPULSBESTIMMUNG VON μ MESONEN IN EINEM HOCHENERGIESPEKTROGRAPHEN]
W. D. Dau. Apr. 1967 46 p refs In GERMAN; ENGLISH summary
(BMWF-FBK-67-31)

The momentum of cosmic ray muons can be measured by means of a magnetic spectrograph. Two trays of Geiger–Müller counters are placed above and two trays below the field of an electromagnet. When a muon traverses the telescope one counter discharges in each tray. The momentum of the muon then can be calculated in a rough manner out of the geometrical positions of the discharged counters. An electronic computer was developed for the calculation of the momentum. The computer is based on analog circuits. The polarity of the output pulse refers to the sign of charge of the muon and the height is proportional to the momentum. The triggering pulse appears nearly 5 μsec after a muon has passed the counter arrangement. Author (NSA)

N68-12717# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF THE GYROTHEODOLITE GI–B1 [ISSLEDOVANIYE GIROTEODOLITA GI–B1]
Fekher Derd' 16 Jun. 1967 24 p Transl. into ENGLISH from Izv. Vysch. Ucheb. Zaved., Geod. i Aerofotos. (Moscow), no. 4, 1964 p 57–66
(FTD-MT-65-149; AD-661014)

The article discusses the general principles of the three-degree-of-freedom gyroscope and considers especially one with a gyroscopic pendulum. The method is outlined by which such a device may be used to measure displacements on the earths surface. The Gi-B1 gyrotheodolite was designed on this basis. It was designed for independent determination of astronomic azimuth with a mean square error of plus or minus 20 min during a period of 30-45 minutes at latitudes up to 70 deg during any part of the day or year at air temperatures ranging from -30 to +50C, regardless of local conditions or magnetic anomalies and can be used underground. It is a composite instrument including, with the gyrotheodolite as the main element, a power unit, a tripod, a connecting cable, and a storage battery. The theodolite weighs 21 kg, the power unit 11 kg. The horizontal circle (nondetachable) is patterned after the Ti-B1 second theodolite, which differs from the first by having a built-in autocollimation system and an auxiliary reading microscope for the optical micrometer, and by a larger horizontal circle. The parameters of all parts of the horizontal circle are given. The mean square error in horizontal direction measurement from a single reading is plus or minus 0.8 min. The power for the gyroscope is three-phase alternating current--30 plus or minus 10% V and 416.6 plus or minus 5% cycles. TAB

N68-12730# Kiel Univ. (West Germany).
A CO_2 PROPORTIONAL COUNTER DEVICE FOR RADIOCARBON DATING [UEBER EINE ANLAGE FUER RADIOKARBON-DATIERUNGEN MIT EINEM CO_2 PROPORTIONAL-ZAEHLROHR]
H. Erlenkeuser. Apr. 1967 31 p refs In GERMAN; ENGLISH summary
(BMWF-FBK-67-32)

A description of an apparatus for radiocarbon dating is given. A copper built 4.5 l CO_2 proportional counter is used. The sensitive counter volume is screened by a tube of highly purified quartz material in order to eliminate wall contamination. The counter is surrounded by 4.5 cm of selected lead followed by 25 resp. 36 Geiger–Müller anticoincidence counters and finally by 10 cm of old lead. Working pressure is 500 Torr, up to 3 atm are possible. At 500 Torr background is 27 resp. 20 cpm. For 48h counting dating limit is 35.000 a. An analysis of background is given and a list of measurements. Author (NSA)

N68-12739 Instituto di Ricerche Breda S.P.A., Milano (Italy).
AN INTRODUCTION TO QUANTITATIVE AUTORADIOGRAPHY
P. Logi and A. Vanossi. Brussels EURATOM 1967 33 p refs
(Contract EURATOM-008-62-10 IRAI)
(EUR-3495.E)

Autoradiography, where used to obtain qualitative information on the distribution of a labelled element, proves to be a powerful research tool. Quantitative autoradiography however, presents considerable difficulties both with respect to execution and

interpretation of the results. Mathematical models developed for a quantitative approach to the problem lead to necessarily approximate theories. Experimental quantitative techniques (grain or track counting) cannot be easily applied because of the great number of not precisely controllable factors. The employment of α-emitting radioisotopes could actually facilitate track-counting, but unfortunately those isotopes are seldom used in research on element distribution. Of the methods described in the literature, the optical-density measurement of the developed autoradiograph seems preferable. The difficulties occurring with this technique can be reduced and the operation-time much lowered, by using standard radioactive sources in the form of thin small discs of photographic gelatine film containing a soluble salt of the radioisotope. A certain number of these standards are prepared for each β-emitting isotope, with various increasing concentrations. Author

N68-12772*# Stanford Research Inst., Menlo Park, Calif.
CRYOGENIC MAGNETOMETER DEVELOPMENT Midterm Report
William S. Goree Oct. 1965 41 p refs
(Contract NAS2-2088)
(NASA-CR-73157) CFSTI: HC $3.00/MF $0.65 CSCL 14B

A superconducting circuit is being adapted to permit a cryogenic magnetometer to measure the rectangular component of small magnetic fields with resoluton of at least 10^{-6} gauss. At the same time a magnetic shield is being developed for testing the superconducting magnetometer at liquid helium and room temperatures. Detailed background information is included for both the magnetometer and the magnetic shield; and some experimental studies are reported for these as well as for the long-term stability and temperature sensitivity of flux gate sensors. M.W.R.

N68-12773*# Stanford Research Inst., Menlo Park, Calif.
CRYOGENIC MAGNETOMETER DEVELOPMENT Interim Report
William S. Goree 23 Aug. 1965 30 p
(Contract NAS2-2088)
(NASA-CR-73156; Rept.-13) CFSTI: $3.00 CSCL 14B

Long-term stability and temperature sensitivity tests are reported for two flux gate sensors. Drifting of less than 1 μgauss over a 10-hr period is reported, and observed sensor drift is always associated with a sensor temperature change. Tests indicate that the temperature coefficient of the sensor is probably not a simple linear function of temperature, and that the average steady state coefficient is about -0.4 μgauss/°C. A superconducting magnetic shield provided the test environment for these studies relating to the development of a cryogenic magnetometer. M.W.R.

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N68-11916 Laboratorio de Acustica e Sonica, Sao Paulo (Brazil).
ULTRASONIC INSPECTION OF THE STRUCTURAL COMPONENTS OF C-45 AIRCRAFT OPERATED BY FORCA AEREA BRASILEIRA [INSPECAO ULTRA-SONICA DAS TRELICAS DOS AVIOES C-45 OPERADOS PELA FORCA AEREA BRASILEIRA]
L. X. Nepomuceno [1967] 6 p In SPANISH
(TR-6703.286/A)

Data are presented on the results of ultrasonic inspection of the structural strength of welded joints in five aircraft. Transl. by T.Z.D.

N68-11929# ARO, Inc., Arnold Air Force Station, Tenn.
A THEORETICAL AND EXPERIMENTAL INVESTIGATION OF A SPHERICAL GAS JOURNAL BEARING Final Report, Jun. 1965-Jun. 1967
A. E. Hodapp, Jr. (M.S. Thesis—Tenn. Univ., Knoxville) Arnold Eng. Develop. Center Oct. 1967 123 p refs
(Contract AF 40(600)-1200)
(AEDC-TR-67-222; AD-660546)

An externally pressurized spherical gas journal bearing, which has multiple spherically surfaced pads, was designed and fabricated for use as a three degree-of-freedom pivot which will support large loads (100 lbs). This inherently compensated pool type bearing design proved to be pneumatically unstable. The problem then was to determine a restrictor configuration for this bearing which would insure pneumatic stability and a large load carrying capacity. Restrictor configurations investigated were inherent compensating both with and without a pool and orifice compensating without a pool. A model bearing, which duplicates the lubricating film of a journal bearing pad, was constructed in order to obtain experimental data to verify the theoretical predictions. For this particular bearing configuration operating at large supply pressures (800 psig), it was found that an inherent compensating restrictor without a pool will ensure pneumatic stability and maximum load carrying capacity. Author (TAB)

N68-11989# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
LABORATORY DEVELOPMENT OF THE GRIND-LEACH PROCESS FOR THE H.T.G.C.R. FUEL CYCLE. PART 3: COMMINUTION OF BERYLLIA MATRIX FUELS
M. G. Baillie and R. W. Hubery Oct. 1966 18 p refs
(AAEC/E-162)

A comminution process has been studied for the preparation of fuel from an HTGCR pebble bed reactor for leaching prior to purification and recycle of its valuable constituents. The selection of suitable equipment for this step is discussed, and experimental work to demonstrate a three-stage vibratory grinding circuit on a small scale, using inactive fuel, is described. It has been shown that, for inactive fuel, a ground product having characteristics which make it suitable for feed material to the selective leaching step can be produced by this technique. Author (NSA)

N68-12021*# National Aeronautics and Space Administration, Washington, D. C.
PIPING AND TUBING TECHNOLOGY: A COMPILATION
1967 22 p
(NASA-C-67-03) CFSTI: HC $3.00/MF $0.65 CSCL 13K

As part of NASA's Technology Utilization Program, summary information on potential industrial applications of developments in piping and tubing is presented. These tools, devices, and techniques, along with design features of piping joints and disconnects, were developed by NASA centers and their contractors and are described in short fact sheets containing a summary of the technology involved as well as a simplified mechanical drawing and the patent status. Individual tools mentioned include tube stripping and plating tools, dies, and adapters. Devices such as the use of spiral wound strips to support jacketed pipes are presented along with such techniques as tube tapering by electrochemical processes. E.J.S.

N68-12066*# National Aeronautics and Space Administration, Washington, D. C.
SELECTED SHOP TECHNIQUES: A COMPILATION

1967 20 p
(NASA-C-67-02) CFSTI: HC $3.00/MF $0.65 CSCL 13H

An electronic warning device that produces audible and visual signals for critical machining; an adjustable gauge that accurately determines the center line of clevis holes; an adapter that speeds up the measurement of surface flatness; and a holder for facilitating the use of a template gauge used to inspect form blocks, contour boards, and other machined items, are described. Other machine tools and fixtures described include: 1) a dividing head adapter, 2) drill press clamp, 3) grinding wheel dresser, 4) handbrake, 5) saw vise, 6) contour and radius generating devices, 7) matching tool, 8) polishing tool, 9) drill presses, 10) cutting tools, 11) guide pin, and 12) a lapping tool. L.S.

N68-12122# Picatinny Arsenal, Dover, N. J. Plastics and Packaging Lab.
FLUIDIZED SED POLYMERIC COATING OF LARGE STEEL MISSILE CONTAINER
John J. Veliky Oct. 1967 13 p
(PA-TR-3569; AD-661290)

The work described in this report is part of an overall program to improve the corrosion resistance of steel munitions containers, which are exposed to the hazards of world-wide handling, shipping, and storage. In general, the program includes two approaches: more durable coatings; and the fabrication of containers from low-alloy steels offering a greater resistance to oxidation. The part of the program reported on involved the search for a better method of coating, using the fluidized bed process. In this process the object to be coated is pre-heated, then immersed in an air-suspended bed of finely divided, powdered polymer, resulting in the fusing of the polymer to the heated object. A cylindrical Littlejohn steel missile container, approximately 100 inches long and 25 inches in diameter, was coated by the fluidized bed method. Up to the present time, this container is the largest object that has been coated by this process. In spite of application problems and increased costs as compared to painting, tests to date indicate that the process holds promise as a more durable method of coating munitions containers. Author (TAB)

N68-12162# Atomic Energy Establishment, Winfrith (England).
THE USE OF A COMPUTER AND A TAPE-CONTROLLED DRILLING MACHINE, FOR THE PRODUCTION OF FUEL ASSEMBLY CLUSTER PLATES
R. K. Hilton and G. M. Wells Sep. 1966 29 p
(AEEW-M-699) CFSTI: HC $3.00/MF $0.65

Improved techniques which are now in use for the design and manufacture of complex fuel assembly cluster plates for zero-energy reactors are described. Laborious hand calculation of hole coordinates has now been replaced by a computer program written in FORTRAN which optimizes the physics design and prints out the rectangular coordinates of each hole. A subroutine POT has been prepared which enables the KDF 9 computer to produce the 5-hole standard paper tape used to feed the tape-controlled drilling machines. NSA

N68-12205# Union Carbide Nuclear Co., Oak Ridge, Tenn. Y-12 Plant.
AIR-BEARING SPINDLE FOR MACHINE TOOLS—SPHERICAL DESIGN
P. J. Steger 29 Sep. 1967 37 p refs
(Contract W-7405-ENG-26)
(Y-1581) CFSTI: HC $3.00/MF $0.65

Externally pressurized air-lubricated spindles using porous graphite compensation have been improved using hemispherical, self-aligning bearings. The spindles are simpler and easier to fabricate and assemble when compared to the air spindle, previously fabricated, which used the cylindrical journal and flat thrust design. This improvement has increased the suitability and economical feasibility of the air-bearing spindle for routine shop use, while maintaining load capability, dynamic stability, thermal stability, and rotational accuracy. Three spherically designed air-bearing spindles fabricated have successfully passed the test stage, and are presently in use on numerically controlled turning and boring machine tools. Author (NSA)

N68-12272# Army Materials Research Agency, Watertown, Mass.
A REPORT GUIDE TO ULTRASONIC TESTING LITERATURE, VOLUME 5
Kenneth A. Fowler and Charles P. Merhib Jun. 1967 144 p refs
(AMRA-MS-67-06; AD-660790)

Where available, each item in this Journal consists of the following information: (1) item, report, or article title, (2) author or authors, (3) source or facility, (4) report number or identification, (5) date, and (6) abstracts. Word descriptors pertinent to each item are listed in alphabetical order and are cross-referenced by the AMRA identification number. Also provided is an author index or, if no author is available, then the issuing organization is listed. Author (TAB)

N68-12286# Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy.
INVESTIGATION OF SOLIDIFICATION OF HIGH-STRENGTH STEEL CASTINGS Interim Report, Oct. 1, 1965–Sep. 30, 1966
M. C. Flemings, R. V. Barone, and H. D. Brody 1 Oct. 1967 97 p refs
(Contract DA-19-020-AMC-5443(X))
(AMMRC-CR-63-04/5; AD-661056)

Analytical and experimental work on microsegregation and dendrite structure in a series of iron base alloys is summarized. Experimental work is on iron-nickel alloys, iron-4% phosphorous alloy, iron-25% copper alloy, and iron-nickel carbon alloys. A new computer analysis for microsegregation is presented, with detailed numerical results given for iron-26% nickel alloy, iron-10% nickel alloy, and iron-4% phosphorous alloy. Results agree reasonably well with experiment provided the dendrite arm spacing used in calculation is less by a constant correction factor, g, than that measured (for example g nearly equal to 0.40 for cylinder model, secondary dendrite arm spacing). It is concluded the need for the correction factor arises primarily because the model employed for calculation does not account for ripening during solidification. Structures of the various alloys studied are presented; in some, the dendrite morphology is strongly plate-like; in others, it is fibrous. Over a range of cooling rates from 0.001 C/sec to nearly 1,000,000 C/sec dendrite arm spacing of iron-26% nickel alloy is linearly related to a single power of cooling rate. It is concluded that the dependency results from the predominant effect of coarsening in determining final dendrite arm spacing. Author (TAB)

N68-12440# Soudometal, S. A., Brussels (Belgium).
STAINLESS STEEL CLADDING OF HEAVY GAGE STEELS Quarterly Report, 1 Oct.–31 Dec. 1966
31 Dec. 1966 7 p Prepared jointly with Ghent Univ.
(Contract EURATOM-008-63-12-TEEB(RD))
(EURAEC-1813; EUR-3349; QR-10) CFSTI: HC $3.00/MF $0.65

A new research program to replace the original one has been planned. The initial phase will continue to define the quantitative effect of each welding parameter or condition on the composition of a single-layer metal deposit. The second phase will implement a selection of the optimum solutions for single-layer tape cladding. All the cladding would be effected on slightly alloyed grades of base steels for reactor vessel construction. NSA

N68-12499# Vitro Labs., West Orange, N. J.
DEVELOPMENT OF ELECTROPHORETIC PROCESS FOR COATING T-53 AIR DIFFUSER, EXHAUST DIFFUSER, AND COMBUSTION CHAMBER HOUSING WITH "SERMETEL W", PHASE 1 Technical Report, 21 Jun.–21 Aug. 1967

Kenneth A. Gebler 21 Aug. 1967 12 p
(Contract DAAJ01-67-C-2207(G))
(VL-2488-1-0; AD-661317)

The report covers activities accomplished to develop an electrophoretic coating method for the application of SERMETEL W to all critical surfaces of the exhaust diffuser, has been classified as the best coating available for corrosion protection. Its application to the complex parts included in this program has not been possible by other conventional means. The development of the electrophoretic methods to coat these parts will greatly extend the corrosion protection now afforded by sprayed-on high-temperature aluminum paint. The design and procurement of coating tanks, power supplies, humidification chambers, and miscellaneous materials was made. Utilizing drawings and sections cut from reject parts obtained from ARADMAC, the design and fabrication of jigs and fixtures were started. Design of three jigs and fixtures was accomplished to take advantage of any radial symmetry of the hardware item and to provide flexibility for modification that may be required in later phases of this program. Author (TAB)

N68-12803# Martin Co., Denver, Colo.
CENTER FOR HIGH ENERGY FORMING Quarterly Technical Progress Report
G. A. Thurston 1 Oct. 1967 26 p refs Prepared jointly with Denver Univ.
(Contract DA-19-066-AMC-266(X); ARPA Order 720)
(AMRA-CR-66-05/11; QTPR-9; AD-661057)

A calculation of work done in straining the blank has been added to the computer program that predicts strains in blanks formed into ellipsoidal dies. Test cases have been run to check out the part of the program that computes strains from multiple shots. A stiffer clamping ring has been designed and fabricated in a one-foot diameter size for use in forming experiments. An electromotive forming facility suitable for research in electromagnetic and electro-hydraulic forming is being designed and assembled. A system is being devised to convert the trace from a streak camera to digital information on the displacement-time history of the expanding ring used in strain rate experiments. Analytical and experimental methods are being directed at several different problems in the area of the mechanics of blank deformation due to an explosive charge. A summary of mechanical properties of shocked aluminum and aluminum alloys is included. Work is also in progress on response of explosively formed metals to heat treatment, ductility during forming, and effect of high strain rate on metal structures. TAB

N68-12854*# Republic Aviation Div., Fairchild Hiller Corp., Farmingdale, N. Y.
HIGH TEMPERATURE HYDRAULIC SYSTEM ACTUATOR SEALS FOR USE IN ADVANCED SUPERSONIC AIRCRAFT Semiannual Report
J. Lee 14 Oct. 1966 87 p refs
(Contract NAS3-7264)
(NASA-CR-91054; FHR-2702-3; SAR-3) CFSTI: $3.00 CSCL 11A

This report covers the third six-month period of a program to investigate seal materials and to design seals for high temperature hydraulic actuator application. During this work period, assembly and checkout of the second seal test rig has been completed. Work has progressed in the design, fabrication, and test of candidate seal configurations in the one-inch size. Low pressure testing was conducted on the nickel Foametal wedge seal, the Polymer SP V-seal, and the all-metal lip seal fabricated from Vascojet 1000. The latter design met the leakage requirement of less than one drop per minute during 50 hours of testing at 400°F and for 15.5 hours of testing at 500°F. The V-seal exhibited essentially zero leakage during 50 hours of operation at 400°F and 50 hours at 500°F. However, seal leakage exceeded the one drop per minute requirement after 21.75 hours of testing at 600°F. The nickel Foametal wedge seal developed excessive leakage after 17.5 hours of operation at temperatures of +80 to 400°F. Author

N68-12896# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
MEASUREMENT OF STRONG ACOUSTIC PRESSURES INVOLVING RIGID SURFACES. EQUIPMENT AND STANDARDS [MESURE DE FORTES PRESSIONS SONORES COMPORTANT DES FRONTS RAIDES—APPAREILLAGE ET ETALONNAGE]
Pierre Lienard, Maurice Benard, and Jean Lambourion 1967 6 p refs In FRENCH Presented at the 4th Conf. for Acoustics, Budapest, 17–21 Oct. 1967
(ONERA-TP-491(1967)) CFSTI: HC $3.00/MF $0.65

Measurement of sound pressure is characterized in relation to aerospace applications; and piezoelectric transducers are found to be better measuring devices than capacitive equipment. Both types of devices are illustrated and described in detail; and sound pressures are considered in terms of supersonic detonations. Measuring standards are described. Transl. by M.W.R.

N68-12784# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HOT ROLLING OF BIMETALLIC SHEET WITH A THICK COPPER COATING
V. N. Klimov 5 Sep. 1967 23 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Mashinostro (Moscow), No. 012, 1964 p 161–171
(FTD-MT-65-462; AD-660733)

An investigation was made of the production of steel-copper bimetal, by means of hot rolling of a pack blank by the scheme S-H-H-S permits obtaining bimetallic sheets with a coating thickness of up to 50% and the necessary strength of cohesion. During rolling of bimetallic steel-copper sheets by the indicated scheme, not less than quintuple total reduction of the pack in height, with reduction in the first two passes of not less than 50% at a temperature of heating of 950C, is optimum. To guarantee durable welding of the layers over the entire area it is necessary to ensure reliable protection of the packs during heating before rolling by the creation of protective atmospheres, collaring the pack along the perimeter, etc. The basic advantages of rolling a bimetal by the scheme S-H-H-S are an insignificant degree of irregularity of laminar reduction, the small extent of the region of selective deformation and of losses of the soft component in the burr, the decrease in deformation resistance of the less yielding internal layers. The method can be successfully applied for bonding metals of having great differences in mechanical properties -- for instance, copper with steel. Author (TAB)

N68-12804# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
TUNGSTEN PICK-UP DURING INERT GAS WELDING OF ALUMINIUM
N. W. D. Chrimes Nov. 1966 21 p refs
(AAEC/TM-361)

During the W inert gas welding of Al, small amounts of the electrode material are transferred to the weld pool. W impurities of the order 10 to 100 ppM are generally present and contents of this order cannot usually be detected radiographically. Possible methods of W transfer are discussed. Author (NSA)

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N68-11993# TRG, Inc., Melville, N. Y.
QUANTUM THEORY OF LASER OSCILLATION 1 Interim Scientific Report
S. R. Barone Aug. 1967 84 p refs
(Contract AF 19(628)-5111)
(TRG-057-2; AFCRL-67-0511; SR-2; AD-660600)

The foundations are laid for a quantum theory of laser oscillation based on the assumption that for a suitable choice of statistical ensembles the expectation values of the field vectors are non-vanishing in steady-state. Treating the macroscopic systems that supply energy to the active atoms and remove it from the field according to the dielectric approximation, all expectation values and correlation functions containing a field coordinate are related to expectation values and correlation functions referring to the atomic degrees of freedom alone. Equations of motion for the atomic currents, populations and two-time response functions are derived and solved in a semiclassical approximation. Amplitude fluctuations of the output field due to zero-point field fluctuations are calculated and shown to be finite and in agreement with experiment in several important respects. TAB

N68-12173# ITT Federal Labs., Nutley, N. J.
LASER TELEMETER FOR AIR GUN APPLICATION Final Report, 29 Nov. 1966–29 Apr. 1967
Lucio M. Vallese and Milner W. Wallace Dover N. J., Picatinny Arsenal Jul. 1967 73 p
(Contract DA-28-017-AMC-3455(A))
(AD-661312)

The work of design and fabrication of three Laser Telemeter Units having 18 channels of IRIG telemetry and using a PPM GaAs Laser is described. After a general discussion of the principles of telemetry and of the signal-to-noise enhancement properties of FM, PPM, and PCM systems, a detailed discussion of the electrical and of the mechanical design is presented. Author (TAB)

N68-12289# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
STIMULATED RAMAN SPECTROSCOPY IN HYDROGEN GAS
P. Lallemand and P. Simova Sep. 1967 31 p refs
(Contracts Nonr-1866(16); Nonr-1866(07); Nonr-1866(32); Nonr-1866(28))
(TR-539; AD-661203)

In most substances which exhibit the stimulated raman effect under high intensity laser excitation, the presence of self-focusing makes quantitative measurements almost impossible. It is shown that in hydrogen gas, which has a very high self-focusing threshold, the stimulated raman effect in an amplifier behaves according to the simple parametric theory. The frequency sharpening in the stimulated emission is used to make a quantitative study of the line shift of the Q(1) vibrational line of H2 as a function of pressure, temperature and foreign gas admixture. Some of these results are then used to measure the line width of the Q(1) line in a raman amplifier. Results are presented of these experiments and other cases are discussed in which the stimulated raman effect can be used to yield information about the scatterer. Author (TAB)

N68-12273
VELOCITY VARIATION STUDIES OF SHORT-TIME MOTION PHENOMENA BY MEANS OF A DOPPLER-LASER-INTERFEROMETER
Sep. 1967 5 p Presented at Symp. High Dyn. Pressure, Paris, 11–15 Sep. 1967

In investigating the crushing phenomenon, the variation of motion is measured as a function of time of the surface undergoing the crushing process. Using a Michelson interferometer and a helium–neon continuous wave laser, the velocity variation is determined by the Doppler effect between a constant phase reference beam and a measuring beam reflected from the moving object. The space–time resolution of this method depends on the number of the Doppler frequency periods which are required for the determination. The time–distance diagram is obtained by summing up the continuous values of the object velocity component in beam direction over the time. M.G.J.

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N68-11912*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CONTROL OF CONTAMINANTS IN LIQUID-METAL SYSTEMS
Sol Gorland and Raymond Bilski Washington NASA Dec. 1967 21 p refs
(NASA-TM-X-1432) CFSTI: HC $3.00/MF $0.65 CSCL 18J

The contaminant controls and cleaning procedures used in the SNAP-8 simulation loop, consisting of two sodium–potassium (NaK) loops and one mercury (Hg) loop, minimized both startup and operational problems. Mercury wetting was induced in the boiler and condenser as determined by progressive improvement in the heat-transfer performance. The degree of wetting is an indication of the system cleanliness. The boiler was conditioned in approximately 250 hours of operation without wetting additives. After 384 hours of operation, analysis of a Hg sample by a distillation method indicated no contamination. Oxide plugging in the NaK loops was minimized using the loop-entry procedures developed in the investigation. No plugs occurred because of changes of repairs that required system entry, and only minor partial plugs occurred in over 1500 hours of operation of the NaK loops. Author

N68-11915 Argentina. Comision Nacional de Energia Atomica, Buenos Aires.
STRUCTURAL STUDY OF THE PRE-PRECIPITATION OF Al–Zn AND Al–Zn–Mg ALLOYS [ESTUDIO ESTRUCTURAL DE LA PRE-PRECIPITACION EN ALEACIONES Al–Zn Y Al–Zn–Mg]
Miguel Ipohorski y and Alberto F. Bonfiglioli 1967 20 p refs In SPANISH
(CNEA-188)

Small angle X-ray diffusion measurements show analogies and differences in the atomic scale for the Al–10% Zn and Al–10% Zn–0.1% Mg alloys. Although the intermetallic structure could not be completely determined, a quantitative description is given. Verification of the X-ray diffusion parameters was obtained, without modifying the structure or influencing the kinetics, i.e., flaws that permit the diffusion of intermittent stresses. It was concluded that these experiments are more directly related to intermetallic structures than those conducted using the resistometer. Transl. by T.Z.D.

N68-11935*# General Dynamics/Convair, San Diego, Calif.
ONSET OF CREEP STRESS MEASUREMENT OF METALLIC MATERIALS: CREEP TESTS WITH TITANIUM ALLOYS, PRECIPITATION HARDENING STAINLESS AND MARAGING STEELS
15 Nov. 1967 423 p
(Contract NASw-739)
(NASA-CR-91119; GDC-DBG67-001) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Continuous, tension-loaded, creep tests of 150 and 1000 hours duration were made in the 450° to 650°F range with

apparatus constructed for measurement of average creep deformation in increments of 0.00000015 in. per in. Materials tested were annealed Ti 8Al–1Mo–1V, Ti 6Al–4V and Ti 5Al–2.5 Sn titanium alloys, PH 15-7 Mo Condition RH 1100, PH 14-8 Mo Condition RH 1050, AM-350 SCT and AM-355 CRT stainless steels, and an 18% nickel maraging steel. The tests were made to determine whether halt in creep deformation occurs when metallic materials are stressed at stress levels in the neighborhood of the 0.01 percent elastic limit which prevails at various temperatures to which the materials may be exposed. Test results showed that creep deformations in small amounts occur under the conditions of stress and temperature tested. Experimental difficulties arising from insufficient sophistication in testing apparatus prevented obtaining data of rigorous design significance. Recommendations for apparatus improvements necessary for establishing the extreme precision of temperature control required for fine creep deformation increment measurements are made. Author

N68-12028# Army Materials and Mechanics Research Center, Watertown, Mass.

METALLURGICAL INVESTIGATION OF SEVERAL STRUCTURAL URANIUM BASE Cb–Mo–Zr–Ti ALLOYS

Stanley M. Wolf Sep. 1967 15 p refs

(AMMRC-TR-67-04; AD-661054)

Mechanical and corrosion properties of eleven alpha-beta uranium alloys were determined for various aging and isothermal transformation heat treatments. Eight alloys contained small additions and variations to the basic alloys 1-1/2Mo-1-1/2Cb-1-1/2Zr-1/2Ti, and three contained higher columbium content. The properties of the basic alloy were relatively unaffected by the slight modifications to its composition. High yield strength of 240 ksi and adequate impact energies were obtained. However, the ductility and corrosion resistance did not meet current military specifications. In comparison, the three alloys with higher columbium content exhibited satisfactory ductility, impact energy, and corrosion resistance at the 200 ksi yield strength levels. Author (TAB)

N68-12125 Societe d'Etudes, de Recherches et d'Applications pour l'Industrie, Brussels (Belgium).

INFLUENCE OF SURFACE TREATMENT ON THE CORROSION OF TWO ZIRCONIUM ALLOYS IN PRESSURIZED WATER AND IN SUPERHEATED STEAM AT HIGH TEMPERATURE [INFLUENCE DU TRAITEMENT DE SURFACE SUR LA CORROSION DE DEUX ALLIAGES DE ZIRCONIUM DANS L'EAU SOUS PRESSION ET DANS LA VAPEUR SURCHAUFFEE A HAUTE TEMPERATURE]

M. Warzee, C. Sonnen, and Ph. Berge Brussels EURATOM 1967 35 p refs In FRENCH

(Contract EURATOM-087-66-1-TEEB)

(EUR-3386.f; EURAEC-1894) CFSTI: $3.00

The systematic study of the influence of surface treatment on the corrosion of zirconium alloys, in high temperature water and steam, was carried out in the temperature range 300 to 450°C, during relatively long periods of time. It is concluded that the surface treatment had a very minor effect on the behavior of Zircaloy 2, under such conditions. In the case of a zirconium–2 chromium–0.16 iron alloy, subjected to superheated steam, 450°C–70 kg/cm^2, it seems advantageous to prepare the surfaces by electropolishing. Such treatment reduces appreciably the corrosion rate in the post-transition zone, without affecting the quantity of fixed hydrogen. A deep superficial cold working treatment yielded unfavorable results. Author

N68-12142 India. Dept. of Atomic Energy, Bombay.

EFFECT OF THERMAL TREATMENT ON HARDNESS AND TENSILE PROPERTIES OF Zr–0.5 wt% Nb–1.0 wt % Cr ALLOY

S. Ray, J. L. Mukherjee, and M. L. Mehta 1967 24 p

(BARC-295) CFSTI: $3.00

The purpose of the present work is to examine the hardening of the alloy, Zr–0.5 wt% Nb–1.0 wt% Cr, by thermal treatment. Samples were water quenched from 850, 900 and 950°C, respectively and subsequently tempered between 400 and 700°C. Martensitic transformation takes place in as-quenched alloy and is associated with substantial hardening. The 0.2% yield stress and ultimate tensile stress of the annealed samples are 40,000 and 56,000 psi respectively, whereas those for samples water quenched from 900°C are 105,400 and 135,900 psi. The hardness and strength fall on tempering and an appreciable drop in strength is observed on tempering above 500°C. Examination of structural changes by optical and transmission electron microscopy reveals that solute hardening is a dominant factor to the high hardness of as-quenched martensite. The hardening decreases on tempering due to precipitation of $ZrCr_2$. Author

N68-12145* Douglas Aircraft Co., Inc., Newport Beach, Calif. Astropower Lab.

STRESS CORROSION CRACKING OF TITANIUM ALLOYS AT AMBIENT TEMPERATURE IN AQUEOUS SOLUTIONS Quarterly Progress Report, Jul.–Sep. 1967

Theron L. Mackay Oct. 1967 24 p refs

(Contract NAS7-488)

(NASA-CR-91254; SM-49105-Q4) CFSTI: $3.00 CSCL 11F

The effect of microstructure on stress corrosion cracking of Ti–8Al–1Mo–1V was studied by solution heat treatment at 1600°F, 1800°F, and 200°F. Different amounts of hydrogen, 27–100 ppm, were introduced at the above heat treatments. Ti–8Al–1Mo–1V with solution heat treatments at 1800°F and 2000°F followed by air quenching were immune to stress corrosion cracking in 3% salt solution. Ti–8Al–1Mo–1V with solution heat treatment at 1600°F was susceptible to stress corrosion cracking at these hydrogen concentrations. Transmission electron microscopy studies were made on Ti–8Al–1Mo–1V, Ti–6Al–4V, and Ti–5Al–2.5 Sn. Thin foils were immersed in 5% NaCl solution and stressed by bending. No evidence of any local anodic sites could be detected by this technique. Author

N68-12162# Westinghouse Electric Corp., Pittsburgh, Pa.

CORROSION OF ZIRCALOY-2 AND ZIRCALOY-4 IN HIGH TEMPERATURE AND HIGH PRESSURE BOILING WATER AND STEAM

Sueo Nomura Aug. 1966 11 p refs Transl. into ENGLISH from Japan Atomic Energy Res. Inst. Rept. JAERI-1116

(WAPD-TRANS-73)

Two kinds of Zircaloy-2 and one kind of Zircaloy-4 were corroded in 280°C boiling water and 400°C steam at pressure 64 kg/cm^{2}G. Remarkable corrosion was observed where a stringer was located, and the corrosion was larger in the flowing condition of water or steam than in the stagnant. Further, it was increased with increasing oxygen content of the water or steam. By the weight gain–time curves for the three kinds of specimens, it was indicated that the difference in weight gain was caused by the difference in the reaction rate constants of the different specimens, although the time dependency of weight gain was constant. The difference in the reaction rate constant was considered as due to the morphological difference of the corroded specimen surfaces, by the impedance measurement and optical- and electron-microscopic observation of the surface oxide films of the specimens. Author (NSA)

N68-12215# Oak Ridge National Lab., Tenn.

ELECTRON MICROSCOPE OBSERVATIONS ON THE DISLOCATION ARRANGEMENT IN COPPER SINGLE CRYSTALS IN THE STRESSED CONDITION

J. C. Crump, III and F. W. Young, Jr. [1967] 5 p Presented at the Colloq. on Dislocation Dyn. Conf., Seattle
(Contract W-7405-ENG-26)
(ORNL-P-3117; CONF-670513-3) CFSTI: HC $3.00/MF $0.65

Three Cu single crystals were spring loaded under compression and irradiated at ambient temperature with 2×10^{17} fast neutrons with the stress applied to pin dislocations in their as-stressed position. The crystals were compressed to 500, 100, and 40 g/mm^2. The dislocation configurations in the crystal compressed to 500 g/mm^2 were identical to those observed in Cu samples similarly stressed and then relaxed. Some of the dislocation bundles tended to be aligned along the traces of the conjugate and critical planes. They were composed of primary edge dislocation dipoles and some secondary edge dislocations. For the crystal compressed to 100 g/mm^2 the dislocation arrangements were very different. A number of long dislocations, some in the screw orientation and others in mixed orientation, were observed. Long dislocations, most in a mixed orientation, which lie on the primary slip planes and intersect to form networks, were observed in the crystal compressed to 40 g/mm^2. NSA

N68-12242# California Univ., Livermore. Lawrence Radiation Lab.
DISPERSION STRENGTHENING OF TUNGSTEN BY COVAPOR DEPOSITION
R. L. Landingham and J. H. Austin 24 Feb. 1967 28 p refs
(UCRL-50209) CFSTI: HC $3.00/MF $0.65

A new method is described for dispersion hardening W to improve its creep strength at high temperatures and thus make it more suitable for use in nuclear reactors for space applications. Called the covapor deposition technique, this method involves mixing vapors of WCl_x and $HfCl_x$ and reducing them with NH_3 and H_2 to produce a deposit of W interspersed with fine particles of HfN for strengthening. A by-product of the development of the covapor deposition technique is the discovery that finer grained vapor deposits of W can be achieved by partially nitriding the W to W_2N during deposition and later removing the W_2N by heat treatment above its 900°C decomposition temperature.
Author (NSA)

N68-12304# Oak Ridge National Lab., Tenn. Solid State Div.
DOSE RATE, ANNEALING, AND STRESS-RELAXATION STUDIES OF RADIATION HARDENING IN IRON
N. E. Hinkle, S. M. Ohr, and M. S. Wechsler Feb. 1967 36 p refs Presented at 3d Intern. Symp. on the Effects of Irradiation on Struct. Metals, Atlantic City, 29 Jun.–1 Jul. 1967 Submitted for publication *Its* Paper No. 50
(Contract W-7405-ENG-26)
(ORNL-P-2922; CONF-660607-6)

Effects of dose rate on the increase in yield-stress of a vacuum-melted iron were studied by irradiating tensile samples at dose rates from 2×10^{11} to 3×10^{13} neutrons/cm^2 sec (E>1 MeV) at 95°C in the poolside of the Oak Ridge Research Reactor. For a dose of 4.6×10^{18} neutrons/cm^2 (E>1 MeV), a three-fold increase in yield stress occurred, but there was no variation with dose rate in the range investigated. The possible significance of the absence of a dose rate effect is discussed in general terms. Annealing of the radiation hardening took place at 300 to 400°C with an activation energy of about 3 eV. This range of temperatures coincides with that observed for the dissociation of N from radiation-produced traps after electron irradiation. Several models for the annealing process are considered. Stress relaxation measurements on unirradiated and irradiated Fe and Fe–Si are described. Evidence for the existence of an internal or threshold stress, which must be exceeded for macroscopic dislocation motion, is cited. It is pointed out that the major cause of radiation hardening is the increase in this stress. When account is taken of the increase in internal stress on irradiation, the stress relaxation experiments indicate no change in the activation volume for plastic deformation. Author (NSA)

N68-12350 Commissariat a l'Energie Atomique, Paris (France).
DETERMINATION OF THE SPEED OF EXPANSION WAVES IN THE ALLOY AU4G [DETERMINATION DE LA CELERITE DES ONDES DE DETENTE DANS L'ALLIAGE AU4G]
A. Rauch 15 Sep. 1967 7 p refs In FRENCH Presented at High Dyn. Pressure, Paris, 11–15 Sep. 1967

Two types of measurements are noted for determining the speed of an expansion wave in an aluminum alloy that has been previously compressed by shock wave. The alloy contains 4% Cu, 1.22% Mg, and 1.3% Mn. An indirect method measures the shock wave speed when it is entrapped by expansion waves. The second method, a direct one, is used in this study; and consists of determining the passage of expansion waves by measuring tension drop during the passage. Measurements were made up to 160 kb. Transl. by M.W.R.

N68-12351 Commissariat a l'Energie Atomique, Sevran (France).
ADIABATIC OF COPPER AT ELEVATED PRESSURE [ADIABATIQUE DYNAMIQUE DU CUIVRE A PRESSION ELEVEE]
J. P. Argous and J. Avelile 15 Sep. 1967 10 p refs In FRENCH Presented at High Dyn. Pressure, Paris, 11–15 Sep. 1967

The dynamic adiabatic for copper at elevated pressures between 3 and 5 megabars is presented. These pressures were obtained by accumulating the shock of a metallic projectile, starting with a converging detonation wave in an angle of about $\pi/2$. With the help of classical techniques, results are also included for lower pressures. The experimental method used is described, and tabulations are included for both the high and low pressure ranges. Transl. by M.W.R.

N68-12352 Ecole Polytechnique, Paris (France).
ON THE VISCOPLASTICITY OF METALS [SUR LA VISCOPLASTICITE DES METAUX]
J. Zarka 15 Sep. 1967 18 p refs In FRENCH Presented at High Dyn. Pressure, Paris, 11–15 Sep. 1967
CFSTI: $3.00

Both the qualitative and quantitative viscoplastic properties of metals are considered; and a model is proposed for one-dimensional viscoplasticity. This model can be extended to the case of anistropic three-dimensional viscoplasticity for monocrystals and polycrystals. Further, the model can be used for many cases of loading. Additional equations are evolved for determining compression and relaxation curves; and the impact of a rod against a rigid wall is investigated. Some experimental results are mentioned. Transl. by M.W.R.

N68-12355 Commissariat a l'Energie Atomique, Gramat (France).
EVALUATION OF THE ELASTIC LIMIT OF COPPER AND URANIUM BY SLOW IMPLOSION [EVALUATION DE LA LIMITE ELASTIQUE DU CUIVRE ET DE L'URANIUM PAR DES EXPERIENCES D'IMPLOSION "LENTE"]
D. Verney 15 Sep. 1967 7 p refs In FRENCH Presented at High Dyn. Pressure, Paris, 11–15 Sep. 1967
CFSTI: $3.00

A theoretical model of elastic-plastic flow in geometric spheres is presented, along with an approximation for incompressible flow and an application to a hollow metallic sphere. Data are included for the elastic limit for copper and uranium based on slow implosion data. These data indicate that although it is possible to derive information of residual deformation and temperature of metallic samples recovered after an incomplete implosion, determining the optimal geometries is difficult. Transl. by M.W.R.

N68-12361# Rutgers Univ., New Brunswick, N. J. Dept. of Mechanical and Aerospace Engineering.
AN INVESTIGATION OF THE MECHANISMS OF EROSION BY IMPINGEMENT Progress Report

Mark B. Moore Jun. 1967 9 r
(Contract AT(30-1)-3477)
(NYO-3477-11) CFSTI: HC$3.00/MF$0.65

Three separate modes of erosion of ductile metals, using an air suspension of small glass spheres at room temperature as the erosion medium, were identified and examined. The first phase occurs when each impinging particle approaches in a direction nearly perpendicular to the eroded surface, each particle hits the surface only once, and each particle rebounds clear of the surface. The loss of mass in this phase seemed to be due to intercrystalline fatigue. The second phase occurs when the particles approach the surface at an angle other than perpendicular, impinge once, and remain in contact with the surface, moving along the surface. A third phase of erosion appears when the angle of impingement is near 45°. Distinct steps or ridges appear on the surface. This stepwise erosion seemed to be a metal-flow phenomenon. NSA

N68-12380# European Atomic Energy Community, Brussels (Belgium).
INFLUENCE OF SURFACE TREATMENT ON VARIOUS TYPES OF STAINLESS STEELS CORROSION
J. Ph. Berge 9 Feb. 1966 18 p refs Presented at 3d Intern. Conf. on Metallic Corrosion, Moscow, 16–25 May 1966
(EURAEC-1709; EUR-2691.e; CONF-660514-5) CFSTI: HC $3.00/MF$0.65

The preparation of a metallic surface frequently has a considerable influence on its subsequent corrosion behavior. The distinction made between the three surface state characteristics is: geometric characteristics (roughness); chemical characteristics mainly, passivation layers that may be characterized by an electrochemical method involving the coulometric reduction of this oxide layer in sulfuric acid; and physical or structural characteristics. The superficial cold-work may be assessed by metallographic techniques on sections and by enlargement of the X-ray diffraction lines. The roughness affects the overvoltage in electrochemical reactions; pitting corrosion in ferric chloride is greatly influenced by surface roughness. The effect of initial passivation is very marked in all corrosive media that are not themselves passivating. Superficial cold-work may also modify the corrosion behavior considerably, stress corrosion in magnesium chloride, intergranular corrosion in nitric acid with hexavalent Cr addition, and oxidation in superheated steam. Author (NSA)

N68-12415# Brookhaven National Lab., Upton, N. Y.
THE CRITICAL SHEAR STRESS OF CUBIC CRYSTALS WITH DEFECTS OF TETRAGONAL SYMMETRY. 3: ELECTRON- AND NEUTRON-IRRADIATED ALUMINUM AS WELL AS ELECTRON-IRRADIATED COPPER
W. Frank Sep. 1967 11 p refs Transl. into ENGLISH from Phys. Status Solidi (Germany), v. 18, 1966 p 459–464
(BNL-TR-162) CFSTI: HC$3.00/MF$0.65

Electron- and neutron-irradiated aluminum and electron-irradiated copper contain dispersed interstitial atoms in dumbbell configurations. It is shown that in these cases the radiation-induced increase of the critical resolved shear stress can be explained quantitatively in terms of elastic short-range interactions between dislocations and interstitials close to the dislocation slip planes. Author (NSA)

N68-12469# Societa Ricerche Impianti Nucleari, Saluggia (Italy). Centro Ricerche Nucleari.
EFFECT OF NITROGEN ON THE MECHANICAL PROPERTIES OF NEUTRON IRRADIATED PURE IRON
M. Castagna, F. S. Rossi, A. Ferro, and J. Sebille 1 Jul. 1966 32 p refs Presented at 3d Intern. Symp. on the Effects of Irradiation on Structural Metals, Atlantic City, 29 Jun.–1 Jul. 1966
(Contract EURATOM-004-63-10-TEEI)
(EURAEC-1472; EUR-2393.e; CONF-660607-10) CFSTI: HC $3.00/MF$0.65

An investigation was made of the role of interstitials, and more particularly of N, on the changes of mechanical properties of iron after fast-neutron irradiation and after annealing. The changes in mechanical properties of pure Armco iron remelted in vacuo and with the last traces of interstitials completely blocked by suitable titanium addition were determined on specimens of different grain sizes. This material showed a value of k_y in the Petch equation extremely low: the value of δ_0 in the Petch equation increased linearly with Ti concentration. After irradiation up to 1.4×10^{19} nvt (>1 MeV) at a temperature below 55°C, this material showed somewhat anomalous Petch lines, with higher values of k_y in the coarse-grain range and a low value in the fine-grain-size region. Author (NSA)

N68-12527# Union Carbide Corp., Oak Ridge, Tenn. Nuclear Div.
BASIC ELECTRICAL DISCHARGE MACHINING CHARACTERISTICS AND ASSOCIATED ELECTRODE MATERIALS AND COOLANTS
D. R. Alford 8 Sep. 1967 44 p
(Contract W-7405-ENG-26)
(Y-1582) CFSTI: HC$3.00/MF$0.65

Electrical discharge machining (EDM) charactertistics of some commonly machined materials, such as uranium, aluminum, steel, and tungsten, have been studied and tabulated at the Y-12 Plant. To a lesser extent, the characteristics of magnesium, titanium carbide, tungsten carbide, and Type 304L stainless steel have also been determined. Data obtained from 15 different electrode materials applied on the workpiece materials in various combinations have been arranged to give shop personnel the information necessary to select and design an electrode, estimate the job time, and set up the power supply. Author (NSA)

N68-12544*# Douglas Aircraft Co., Inc., Newport Beach, Calif. Astro.
STRESS CORROSION CRACKING OF TITANIUM ALLOYS AT AMBIENT TEMPERATURE IN AQUEOUS SOLUTIONS
Theron L. Mackay and C. B. Gilpin Jun. 1967 87 p refs
(Contract NAS7-488)
(NASA-CR-91115; SM-49105-F1) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Stress corrosion tests in distilled and aqueous salt solutions were made at ambient temperature employing single edge notch specimens of titanium alloys. The all-beta alloy (Ti-13V-11Cr-3Al) showed no appreciable susceptibility to stress corrosion cracking while alpha–beta and near-alpha alloys (Ti-8Al-1Mo-1V and Ti-5Al-2.5Sn) did exhibit SCC. Electron microfractographs of the stress corrosion fractures of alpha–beta and near-alpha alloys showed a mixture of cleavage and ductile dimple rupture. Cleavage areas were larger in salt solution tests. Profiles of the fractured surfaces showed that cleavage occurred in the alpha phase and at the alpha–beta phase boundaries. Author

N68-12551# Brookhaven National Lab., Upton, N. Y.
DEFECT STUDIES IN METALS
M. J. Attardo, J. L. Davidson (Columbia Univ., New York), J. M. Galligan, and D. Jeannotte (IBM, East Fishkill, N. Y.) [1967] 20 p refs Presented at Intern. Conf. on the Strength of Metals and Alloys, Tokyo Sponsored jointly by AEC and NSF
(BNL-11717; CONF-670909-7) CFSTI: HC$3.00/MF$0.65

Some measurements of defects present in crystals as a result of irradiation or quenching are presented. It is shown that interstitial atoms are removed from Pt in stage III recovery. The presence of depleted zones is shown to be a controlling factor in the change in yield stress in irradiated Pt. In irradiated W the energy of motion of single vacancies has been measured. The process takes place with an activation energy of 3.3 eV. This result precludes extensive motion of vacancies in W in stage III recovery. Some studies of quench hardening in Cu show that the hardening

occurs in two stages if the quenching is performed under clean conditions. The second stage is associated with the growth of Frank dislocation loops and an experimental value of the rate limiting process for plastic deformation is about 4.5 eV. Author (NSA)

N68-12559# Bettis Atomic Power Lab., Pittsburgh, Pa.
THE CORROSION AND HYDROGEN ABSORPTION CHARACTERISTICS OF ZIRCONIUM ALLOYS CONTAINING IRON, CHROMIUM, TIN, AND NIOBIUM
Stanley Kass Feb. 1967 61 p
(Contract AT(11-1)-GEN-14)
(WAPD-TM-543) CFSTI: HC$3.00/MF$0.65

The corrosion and hydrogen absorption properties of Zr base alloys containing 0.5 or 1.0% Fe, 0.5 or 1.0% Cr, 0 or 0.5% Sn, and 0 or 0.5 % Nb in high temperature water and steam have been studied. All alloys containing Nb exhibited higher strength characteristics than the corresponding Nb-free alloys and were stronger than both Zircaloys-2 and -4. The alloy containing 0.5% Fe, 1.0% Cr, 0.5% Sn and 0.5% Nb exhibited a low corrosion rate, approximately equal to that of the Zircaloys and at the same time absorbed very small amounts of H_2, approximately half as much as Zircaloy-4, during aqueous corrosion exposure.
Author (NSA)

N68-12571# Societa Ricerche Impianti Nucleari, Saluggia (Italy). Centro Ricerche Nucleari.
INFLUENCE OF NITROGEN IN IRON AND STEEL UNDER FAST NEUTRON IRRADIATION Annual Report
Brussels EURATOM Nov. 1966 77 p refs
(Contract EURATOM-074-65-10-TEEI(RD))
(EURAEC-1773; EUR-3321) CFSTI: HC$3.00/MF$0.65

Results are reported for studies on: properties of Fe alloys, including tensile, impact, and fracture tests; radiation effects on magnetic properties of Fe alloys and pure Fe; neutron spectrum influence on radiation damage in Fe; and mechanical properties of modified ASTM A212 steels, including transition temperature of the materials and a structure analysis in different heat treatment conditions. NSA

N68-12634# Societa Ricerche Impianti Nucleari, Saluggia (Italy). Centro Ricerche Nucleari.
INFLUENCE OF NITROGEN IN IRON AND STEEL UNDER FAST NEUTRON IRRADIATION Quarterly Report, Apr. 1-Jun. 30, 1967
F. S. Rossi Jul. 1967 8 p ref
(Contract EURATOM-074-65-10 TEEI (RD))
(EURAEC-1919; EUR-3750; QR-7) CFSTI: HC$3.00/MF$0.65

The tensile properties of irradiated and unirradiated Ferrovac E and of unirradiated Fe–Ti alloy specimens at different temperatures and strain rates were measured. The secondary hardening peak was determined on unirradiated ASTM A212 base steels killed with Si, Al, Ti after quenching from 1100°C and tempering at 600°C. Tension data were compared with hardness tests and precipitated nitrogen concentration. Damage dosimetry studies with measurement of the irradiation induced modifications in Ultraperm magnetic properties were continued and some tests were also done to study the interaction of carbon and nitrogen atoms with the irradiation defects. Some electron micrographs were also done of replicas obtained from the broken tensile specimens of Ferrovac E and Fe–Ti alloys. Author (NSA)

N68-12674# Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.
PLASTIC DEFORMATION OF ZIRCONIUM DURING OXIDATION
F. Bollenrath and F. E. Buresch [1967] 8 p refs Transl. into ENGLISH from Metaux (Corrosion-Ind.) (Paris), v. 41, 1966 p 402–404
(WAPD-TRANS-72) CFSTI: HC$3.00/MF$0.65

The deformation of sheets and tubes produced during the corrosion of Zr or its alloys was previously described and it was affirmed that the deformation appears completely only after the black–white transformation. However, it was clearly shown that during corrosion tests the deformation appears from the beginning of this phenomenon. This applied both to tubes and to fine sheets. From the beginning of the corrosion they undergo multiaxial tension and can pass the elastic limit, which leads to the plastic deformation of the metal. This explains that the resistance to corrosion of Zr and its alloys is a function of the resistance to deformation, that is, of the mechanical properties at the operating temperature. In the case of assemblies it is possible that this deformation can be considerably inhibited by the conditions of assembling. Author (NSA)

N68-12682# Argonne National Lab., Ill.
IRRADIATION OF URANIUM WITH NEUTRONS AT 4.5°K [IRRADIATION D'URANIUM PAR DES NEUTRONS A 4.5°K]
G. Burger, K. Isebeck, H. Wenzel, J. C. Jousset, and Y. Quere [1967] 11 p refs Transl. into ENGLISH from Phil. Mag. (Munich), v. 8, no. 11, Mar. 1965 p 621–625 Presented at the 10th Met. Colloq. on Fragility and Effects of Irradiation, Saclay (France), Jun. 1966
(ANL-TRANS-432; CONF-660656-1) CFSTI: HC$3.00/MF$0.65

A liquid helium temperature irradiation of pure uranium is described. The initial resistivity increases are given for various textures of the metal. It is shown that there exists in uranium a very mobile defect which anneals out between 4 and 20°K. Author (NSA)

N68-12684# General Electric Co., Cincinnati, Ohio. Nuclear Materials Propulsion Operation.
OBSERVATION OF HELIUM BUBBLES IN AN IRRADIATED AND ANNEALED AUSTENITIC STEEL
D. A. Woodford, J. P. Smith, and J. Moteff 25 Aug. 1967 29 p refs Presented at the Am. Inst. of Mech. Engr., Cleveland
(Contract AT(40-1)-2847)
(GEMP-544; CONF-671010-1) CFSTI: HC$3.00/MF$0.65

Post-irradiation transmission electron microscopy was performed on a split heat of a high temperature Fe base precipitation hardened alloy (A 286) containing 0.001 w/o and 0.010 w/o natural B. Irradiation was performed at reactor ambient temperature to a fluence of 4.8×10^{19} n cm^{-2} ($E_n>1$ MeV) and 6.5×10^{20} n cm^{-2} (thermal). Following irradiation, individual specimens were then heat treated at 760, 845 and 995°C and examined by transmission electron microscopy. These studies show that all three heat treatments produced visible He bubbles. Analysis of the bubble sizes and size distribution indicates, for a given temperature, the higher B content alloy yields a larger mean bubble diameter. Also, the mean diameter increases with increasing anneal temperature for both B contents. Measurements and subsequent calculations of the observed He volume agrees quite well with what one would predict based on the ^{10}B atom concentration and thermal neutron fluence. The results of these studies also showed that virtually all of the He is associated with dislocations, and only a small fraction lies at grain boundaries or prime precipitate particles. These results indicate that a contributing factor to the observed radiation-induced embrittlement may be caused by bubbles pinning dislocations especially in areas adjacent to grain boundaries. This would restrict dispersal of stress concentrations at grain boundary triple points. Another significant observation is the presence of "shells" of He bubbles surrounding the precipitate particle TiN. The radii of the shells are approximately equal to the recoil distance of an α particle in an Fe matrix. Author (NSA)

N68-12686# General Electric Co., Pleasanton, Calif. Nuclear Technology Dept.
THE EFFECT OF CATHODICALLY CHARGED HYDROGEN ON CRACK GENERATION IN TYPE-304 STAINLESS STEEL

E. G. Brush Mar. 1967 42 p refs
(Contract AT(04-3)-189)
(GEAP-5415; EURAEC-1914) CFSTI: HC $3.00/MF $0.65

An evaluation of the role that corrosion-generated H_2 might play in assisting propagation of anodically-generated cladding cracks in nonsensitized Type-304 stainless steel cladding on boiling water reactor fuel is presented. NSA

N68-12710# Iowa State Univ. of Science and Technology, Ames.
PLASTIC DEFORMATION BEHAVIOR OF LONG RANGE ORDERED IRON–ALUMINUM ALLOYS
Harry John Leamy (Ph.D. Thesis) Aug. 1967 166 p refs
(Contract W-7405-ENG-82)
(IS-T-180) CFSTI: HC $3.00/MF $0.65

The plastic deformation behavior of long range ordered alloys of Fe and Al has been examined by means of compressive deformation testing and transmission electron microscopy. Alloys in the range of compositions studied, 22.0 to 30.6 at. % Al, exhibit marked temperature and composition variations in deformation behavior. These variations have been attributed to functional dependencies of the nucleation and interaction of superlattice dislocations upon temperature and antiphase boundary (APB) energies. Single and polycrystalline flow stress curves indicate that, in the temperature range investigated (77°K to 573°K), low temperature deformation is accommodated by the motion of ordinary 1/4 $a_0\langle 111\rangle$ dislocations. Since these dislocations produce antiphase boundaries and cross slip rather easily, low temperature flow stress curves are characterized by high stress levels, short wavy slip lines, and nearly parabolic work hardening behavior. Deformation at higher temperatures is associated with the production of superlattice dislocations whose nucleation is aided by thermal fluctuations. The resultant flow stress curves are characterized by low yield stresses and from one to four linear work hardening stages. Further deformation in these proceeds by the motion of ordinary 1/4 $a_0\langle 111\rangle$ dislocations and the flow stress curve assumes the familiar parabolic form. Transmission electron microscopical observations of deformed single crystal sections indicate that the linear stages are produced by the interaction of superlattice dislocations of DO_3 (four APB coupled 1/4 $a_0\langle 111\rangle$ dislocations) type or B2 (two APB coupled 1/4 $a_0\langle 111\rangle$ dislocations) type. This unique deformation behavior has been treated theoretically on the basis of a simple model for superlattice dislocation nucleation and the work hardening processes have been discussed. Author (NSA)

N68-12713# Sandia Corp., Albuquerque, N. Mex.
DISLOCATIONS IN BERYLLIUM TWINNING AND DEFORMATION BY CLIMB
J. P. Poirier, J. Antolin, and J. M. Dupouy 1966 12 p refs
Transl. into ENGLISH from J. Phys. (Paris), Jul.–Aug. 1966
(SC-T-67-0918) CFSTI: HC $3.00/MF $0.65

Single crystals of Be, compressed along the c axis, above 400°C, undergo a deformation that can be ascribed to the climb of $\vec{c}$ dislocation loops possibly created by Bardeen–Herring sources. Observations of twins gave evidence supporting the theory of twinning by dislocations. Numerous stacking faults were also found in twins; they result from the condensation of vacancies created during twinning. Author (NSA)

N68-12723# Iowa State Univ. of Science and Technology, Ames.
PLASTIC DEFORMATION BEHAVIOR IN IRON–SILICON ALLOYS
Gordon Everett Lakso (M.S. Thesis) Nov. 1966 118 p refs
(Contract W-7405-ENG-82)
(IS-T-128) CFSTI: HC $3.00/MF $0.65

Polycrystalline iron–silicon alloys containing from 0 to 25 at. % Si were compressed at various temperatures and the corresponding true stress–true strain curves were recorded. Alloys containing less than 10.3 at. % Si were found to contain only short range order. This short range order increased both the slip and twinning stresses as the Si content of these alloys increased. On the other hand, a competitive effect due to a decrease in stacking fault energy with increasing Si favored twinning. Alloys with Si concentrations greater than 11.2 at. % contained only DO_3-type long range order. Depending on composition or temperature the stress–strain curves associated with these alloys showed either three stages of work hardening, i.e., stages I, II, and III or only one state, i.e., stage III. Stage I has been attributed to the movement of perfect superlattice dislocations with essentially no interaction between them. Stage III, on the other hand, is due to the motion of imperfect dislocations through the lattice with the resultant production of first or second nearest-neighbor antiphase boundaries. All of the above results have been substantiated theoretically. The polycrystalline aspect of this investigation was extended to include single crystals. Specifically single crystals of Fe_3Si were oriented for single and double slip. In the case of the alloy oriented for single slip, one or three stage deformation was observed, depending on temperature, similar to that observed in polycrystals. Transmission electron microscopy investigations made on specimens cut from these crystals verify the prediction made in Part I. In addition, the stage II hardening has been attributed to Taylor type locking of superlattice dislocations. Work hardening rates approaching that of the elastic limit were observed in the Fe_3Si single crystal oriented for double slip. This has been attributed to the difficulty associated with bowing out superlattice dislocations between the forest dislocations on the second slip system. Also, a number of unique contrast mechanisms associated with the observation of dislocations and antiphase boundaries have been investigated. Author (NSA)

N68-12731# General Electric Co., Pleasanton, Calif. Nuclear Technology Dept.
EFFECTS OF IMPURITY ADDITIONS ON THE INTERGRANULAR CORROSION OF HIGH PURITY FE–CR–NI AUSTENITIC ALLOYS
J. S. Armijo Oct. 1966 20 p refs
(Contract AT(04-3)-189)
(GEAP-5047; EURAEC-1855) CFSTI: HC $3.00/MF $0.65

The effects of alloying additions on the intergranular corrosion of nonsensitized austenitic alloys in boiling HNO_3–dichromate solutions have been determined. Controlled additions of C, N, O, Mn, S, Si, and P to a high purity 14% Cr, 14% Ni, bal Fe alloy and subsequent corrosion tests in boiling 5N HNO_3–0.46N Cr^{+6} splutions showed that only Si and P promote integranular corrosion susceptibility of nonsensitized alloys. Elimination of Si and P from austenitic alloys of otherwise commercial purity eliminates susceptibility to intergranular attack. Author (NSA)

N68-12746# Materials Research Lab., Inc., Richton Park, Ill.
FRACTURE TOUGHNESS OF REACTOR PRESSURE VESSEL STEELS. DEVELOPMENT OF TEST PROCEDURES, FEBRUARY 1–APRIL 30, 1967
E. J. Ripling and P. B. Crosley 31 May 1967 14 p ref
(Contract AT(11-1)-1477)
(COO-1477-8) CFSTI: HC $3.00/MF $0.65

Fracture toughness tests were made on reactor pressure vessel steels as a function of loading rate at ambient (75°F) and 0°F. The specimens were 1 and 2 in. thick with side-groove ratios that varied from b_n/b = 0.50 to 0.75. The cracking plane was parallel to the plate surface and located on the midplane of the 4 in. thick A302 steel plate. It was tentatively concluded that loading rate exerts only a modest influence on toughness over the range studied. On the other hand, rapid loading rates appeared to promote plane strain fracturing. It was also concluded that the measuring capacity of fracture toughness specimens could be increased by the use of very high loading rates. NSA

N68-12757# Mound Lab., Miamisburg, Ohio.
PREPARATION AND TESTING OF METAL COATINGS ON URANIUM

T. W. Wood 30 Aug. 1967 10 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1334) CFSTI: HC $3.00/MF $0.65

A limited study of the resistance to aqueous (sea water, distilled water, and water vapor) corrosion afforded U by four coating processes was performed. The corrosion resistance of ion plates of Al was compared with that of Zn hot dip coatings, and of electroplates and carbonyl coats of Ni vacuum annealed at 700°C. The carbonyl coatings, which showed little effect from four days in 96°C condensing steam, were the most corrosion resistant. Zn hot dip did almost as well. The Al ion plates sometimes corroded severely under these conditions. However, ion plating does not require substrate heating, and modifications of the process may improve performance to that of the other coatings. Ion plates of Al were more corrosion resistant than vacuum annealed Ni electroplates. Author (NSA)

N68-12770# Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.
QUANTITATIVE ANALYSIS OF TEXTURES DEVELOPED IN A HOT-EXTRUDED ZIRCONIUM SLAB
J.-C. Couterne, G. Cizeron, and P. Lacombe 1966 54 p refs Transl. into ENGLISH from Colloq. Met. Commis. Energ. At. (France), v. 9, 1966 p 135–154
(WAPD-TRANS-60) CFSTI: HC $3.00/MF $0.65

The Schulz method was used to study the textures produced in Zr by hot-extrusion of a cylindrical rod at 730°C to form a plate of rectangular cross-section. These textures were determined either parallel to the plane of the plate or parallel to that of the edges (this plane is at right angle to the first and also parallel to the direction of extrusion). Results show that especially near the edges of the plate, some components of the textures observed in the two series of recordings are the same texture seen from two different angles. In addition it is shown that Zr shaped in this way shows two main types of texture: either from cold-work, or from recrystallization following it. Author

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N68-11944*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE EFFECT OF GRAIN BOUNDARIES ON MECHANICAL BEHAVIOR IN POLYCRYSTALLINE CERAMICS
M. H. Leipold, T. H. Nielsen, and E. C. De Wys 15 Dec. 1967 16 p refs
(Contract NAS7-100)
(NASA-CR-91074; JPL-TR-32-1200) CFSTI: HC $3.00/MF $0.65 CSCL 11B

The importance of grain boundaries to the mechanical behavior of ceramics and the importance of mechanical strength to the overall usefulness of ceramics are discussed. The research involved (1) direct observation of the atomic structure of grain boundaries, (2) the chemical nature of the grain boundary and the development of applicable techniques, (3) suitable techniques for production and characterization of specimens, and (4) the development of suitable mechanical test data and facilities. Author

N68-11978*# Southern Research Inst., Birmingham, Ala.
AN INVESTIGATION OF THE MECHANISMS OF HEAT TRANSFER IN LOW-DENSITY PHENOLIC-NYLON CHARS
E. D. Smyly, C. M. Pyron, Jr. and C. D. Pears Washington NASA Dec. 1967 100 p refs
(Contract NAS1-5448)
(NASA-CR-966) CFSTI: HC $3.00/MF $0.65 CSCL 11I

The thermal conductivities of three phenolic-nylon chars having porosities of 0.79, 0.82, and 0.88 were measured in vacuum, nitrogen, and helium environments. The temperature range covered was from 400°F to 1000°F. The pressure range was from 0.002 to 760 torr. The specimens were obtained from virgin materials with densities of 19 lb/ft^3, 30 lb/ft^3, and 42 lb/ft^3 by charring in a 30 percent nitrogen–70 percent argon plasma for 125 to 180 seconds. The input cold-wall heat flux density was 170 Btu/sec-ft^2. The thermal conductivity increased on changing the environment from vacuum to either nitrogen or helium. The increase was greater than could be accounted for by the simple addition of the thermal conductance of the environmental gas to the thermal conductivity measured in vacuum. This discrepancy was explained as an effect due to the thermal shorting of internal delaminations within the char. A thermal model which takes the delaminations into account was developed and correlated with the data. The correlation allowed the isolation of one important intrinsic property of the char, the thermal conductivity of the matrix, assuming that the model describes the physical situation. Author

N68-12014# Aerospace Corp., El Segundo, Calif.
STRENGTH AND STRESS–STRAIN PROPERTIES OF RAPIDLY HEATED LAMINATED ABLATIVE MATERIALS
Alfred Ching and William E. Welsh, Jr. Jul. 1967 35 p refs
(Contract F04695-67-C-0158)
(TR-0158(3240-30)-2; SAMSO-TR-67-27; AD-660534)

It is shown that the mechanical properties of rocket nozzle liners and reentry vehicle ablation materials can be determined by tests in which a high temperature plasma arc is used as a heat source. The arc flow is used to heat slender specimens, and a pneumatically actuated loading frame is used to apply stress. This method of testing provides heating and loading in time periods typical of the rapid heating during rocket firing or reentry, on the order of 10 sec. Earlier investigations of similar ablative materials have used specimens heated and charred (degraded) slowly prior to the application of load. Strength and stress-strain properties in the warp direction were determined for carbon, graphite, and silica phenolic materials. The method appears promising for the determination of properties in various loading-laminate orientations and during thermal expansion, and for studies of heating and strain rate effects on strength at elevated temperatures. Author (TAB)

N68-12105# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ADHESION OF CERTAIN POLYAMIDE FILMS TO METALS AND ALLOYS [ADGEZIYA NEKOTORYKH POLIAMIDNYKH PLENOK K METALLAM I SPLAVAM]
Sh. M. Bilik and Yu. B. Yasson 18 Aug. 1967 23 p refs Transl. into ENGLISH from Tr. Vsesoyuznyy Nauchn.-Issled. Inst. Zheleznodorozhnogo Transp. (Moscow), no. 267, 1963 p 12–24
(FTD-MT-65-486; AD-660739)

Polyamides are used as antifriction materials in a number of machines and instruments. The use of polyamides makes it possible to economize on nonferrous metals and in a number of cases to increase the life span of friction couplings. Capron applied to a metal body of a bearing in the form of a thin layer covering has a number of advantages in comparison with thick walled, cast bushings. The adhesion properties of capron and polymer films to a metal lining was tested on a number of metals, including steel, brass, bronze, anodized and unanodized duraluminum. The difference in adhesive properties was shown with the introduction of several additives. The results of the tests are presented in graphs and tables. An intermediate layer of epoxy resin was used to bind the film to the metal. The results of this adhesion are also given. Author (TAB)

N68-12148# Stanford Research Inst., Menlo Park, Calif.
GROWTH, PROCESSING AND CHARACTERIZATION OF BETA SILICON CARBIDE SINGLE CRYSTALS
R. W. Bartlett and R. A. Mueller Aug. 1967 49 p refs
(Contract F19628-67-C-0243)
(AFCRL-67-0557; SR-1; AD-660587)

A study of epitaxial vapor deposition of beta-silicon carbide on solution grown beta-silicon carbide surfaces was initiated. A literature survey and design and construction of a versatile vapor deposition apparatus were complete. Continuously oriented (111)/(111) beta-silicon carbide deposits were obtained by pyrolysis of methyltrichlorosilane and, independently, silane/propane mixtures. Oxidation experiments were conducted on solution grown beta-silicon carbide platelets in dry oxygen and steam. The oxidation kinetics in the parabolic (diffusion controlled) rate region are identical with those of silicon. Oxide films free of pinhole defects were obtained only by dry oxidation. Metal-oxide-semiconductor structures were fabricated using evaporated aluminum and their capacitance-voltage characteristics were determined at 100 kc. The dielectric constant of the oxide is k = 3.9, as expected for silicon dioxide. Depletion of charge carriers in the semiconductor adjacent to the oxide interface under a dc bias on the aluminum gate was demonstrated through the resulting change in capacitance with gate voltage. The variation in capacitance increased with decreasing oxide film thickness and the results were consistent with the expected net donor concentration in these crystals. Author (TAB)

N68-12189# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.
BEHAVIOR OF URANIA IN A THERMAL GRADIENT AND CONTROL OF URANIA STOICHIOMETRY
R. E. Fryxell 17 May 1967 13 p refs
(Contract AT(40-1)-2847)
(GEMP-516) CFSTI: HC $3.00/MF $0.65

Thermodynamic criteria for fabricating and maintaining a stoichiometric urania composition at high temperatures are summarized. Above 1500°C, O_2 deficiency may develop, the rate and magnitude depending on temperature, environment, and certain other experimental parameters. If O_2 deficiency does not develop, thermal gradients are without effect on the composition. However, composition gradients will develop under thermal gradient conditions if O_2 deficiency exists. The composition profiles exhibit a linear relationship between log (2.00–O/U) and reciprocal temperature, but the apparent enthalpy is dependent on experimental conditions, with a minimum value of about 24 kcal/mole. Author (NSA)

N68-12200# North Carolina State Coll., Raleigh. School of Textiles.
A FUNDAMENTAL RESEARCH STUDY OF THE CONVERSION OF POLYMERS TO FIBERS Technical Report, 1 May 1966–30 Apr. 1967
Robert W. Work and Clarence M. Asbill, Jr. Wright-Patterson AFB, Ohio AF Mater. Lab. Jun. 1967 31 p
(Contract AF 33(615)-3850)
(AFML-TR-67-173, Pt. 1; AD-660583)

In order to do research on the engineering principles which determine the behavior of linear polymers during their conversion to usable fibers, it was necessary first to plan, design and build appropriate dry spinning equipment. Specifications for a research dry spinning operation were developed and a design prepared for a machine to meet these. Purchase of available component parts is under way. Design and fabrication of non-commercially available components are in progress. Assembly was started. The first research will consist of a study of the flow of solutions of linear polymers in true capillaries, the related behavior of these in the 'capillaries' of spinning jets, and the properties of fibers produced from the latter. Author (TAB)

N68-12209# Michigan Univ., Ann Arbor. Infrared and Optical Sensor Lab.
STRUCTURAL RELATIONSHIPS IN VITREOUS INFRARED MATERIALS Semiannual Progress Report, 1 Apr.–30 Sep. 1967
W. C. Levengood and T. S. Vong Nov. 1967 44 p refs
(Contract Nonr-1224(57); ARPA Order 269)
(Rept.-7518-10-P; AD-661216)

Based on considerations of the important role of microyield in glass-structure studies, a linear relationship was found between the breaking strength of glass and microelasticity. This relationship disclosed that the wide spread observed in breaking strength values within one given glass system is due to localized variations in elasticity. Heretofore, these large deviations in strength have been attributed to unresolved factors such as surface contamination, handling defects, etc. Data presented demonstrate a spatial variability in microelasticity, the form of which determines the strength of glass under nonuniform loading conditions. The practical implications in terms of improving the mechanical properties of infrared glasses are discussed. Several predictions suggested by a previously defined unified theory of glass structure are examined and they generally substantiate the fact that variations in the basic glass structure are determined by surface flaw parameters and flaw interactions. In particular, this study confirmed that gases bound within vitreous networks can influence mechanical strength. The surface flaw characteristics and critical stress of flaw formation was determined both in infrared transmitting glasses in a single crystal. The differences in the flaw parameter values for the crystalline solid and the glasses were as predicted. Induced radiation effects were examined in three glasses representing the basic liquid models, and the changes in flaw characteristics are interpreted in relation to liquid model theory. Author (TAB)

N68-12247# Georgia Univ., Athens. Dept. of Physics.
INFRARED SPECTRA OF PLASTICS AND ELASTOMERS AFTER NUCLEAR IRRADIATION Annual Progress Report
W. C. Sears 12 Sep. 1967 13 p refs
(Contract AT(40-1)-2418)
(ORO-2418-3) CFSTI: HC $3.00/MF $0.65

Since molar absorptivity for the trans-vinylene band in trans-1, 4-polybutadiene was found to change with temperature, a study of it has begun to determine applicable absorptivities for analyzing irradiated polymers whose spectra have been measured at elevated temperatures to eliminate crystallinity. It has been found that molar absorptivity drops sharply at 46°C in changing from crystalline modification I to II. There is a possibility that this transition temperature will shift to 76°C after being cooled from above 76°C or to melt at 145°C to room temperature. Applicable transvinylene absorptivities for analyzing irradiated Neoprenes may be evaluated from the Neoprene polymers themselves or from values obtained from trans-1,4-polybutadiene. A study is also in progress on the effects of gamma rays on poly-2-vinylpyridine and a 75/25 copolymer of 1,3-butadiene and 2-methyl-5-vinylpyridine. Author (NSA)

N68-12256# Aerospace Corp., El Segundo, Calif. Materials Sciences Lab.
BASAL PLANE EMITTANCE OF PYROLYTIC GRAPHITE AT ELEVATED TEMPERATURES
Robert J. Champetier Jul. 1967 44 p refs
(Contract F04695-67-C-0158)
(TR-0158(3250-20)-10; SAMSO-TR-67-5; AD-660892)

A direct measurement of the total hemispherical emittance of as deposited PG layers on ATJ graphite cylinders in the range from 1200 to 2840C is described. The method consisted of resistively heating these long, thin cylinders inside a cooled, blackened enclosure until the power generated was all radiated and temperature equilibrium ensued. By sighting an optical pyrometer through a window in the enclosure, the apparent temperature of the surface and the true temperature of a cavity inside the samples

could be measured. These temperatures, as well as the electrical power supplied to the sample, were recorded for each equilibrium temperature. These data for various sample thicknesses were used to determine the true temperature of the surface, the total hemispherical emittance, epsilon-H, and the normal emittance at 0.65 microns. The electrical resistivity in the ab-plane and the thermal conductivity in the c-direction were also determined. The epsilon-H for PG was approximately 0.6 microns from 1300 to 2600C. Exposure for a few seconds in an inert atmosphere or in a vacuum to temperatures above 2600C, irreversibly altered the surface finish and increased epsilon-H to progressively higher values depending on the time and temperature. The normal emittance values at 0.65 microns also were significantly affected. Author (TAB)

N68-12333# Linden Labs., Inc., State College, Pa.
CHEMICAL STRENGTHENING OF CERAMIC MATERIALS Summary Report, 7 Apr. 1966–6 Apr. 1967
Henry P. Kirchner, Robert M. Gruver, Dennis R. Platts, and Ralph E. Walker 7 Apr. 1967 156 p refs
(Contract NOw-66-0441-c)
(AD-652399) CFSTI: HC $3.00/MF $0.65

An investigation of the effect of compressive surface layers on the strength of polycrystalline ceramic bodies is described. Low expansion surface layers were formed on conventional ceramics by chemical reactions at high temperatures. Failure, by shearing of the surface layers, was prevented by establishing gradual variations in composition within the body. Chemical strengthening was attempted with alumina, titania, spinel, magnesia, forsterite, steatite, nickel oxide, silica and cordierite bodies and was achieved with several of these materials. Glazing and quenching also resulted in improved flexural strength. Combined processes involving chemical strengthening, atmospheric treatments, glazing and quenching were investigated. In some cases strength increases of more than 90% were observed. The thermal shock resistance of some of the samples was improved. Abrasion of the surfaces of some of the treated samples did not result in loss of strength. Author (TAB)

N68-12400 General Research Corp., Santa Barbara, Calif.
BEHAVIOR OF SHORT DURATION SHOCKS IN PLEXIGLAS
Donald V. Keller 1967 11 p refs Presented at the Symp. on High Dyn. Pressure, Paris, 11–15 Sep. 1967

Short duration shocks have been induced in Plexiglas targets by impact of thin Plexiglas plates. Previous studies of the peak pressure suffered by these short pulses (shock pressures greater than 15 kilobars) showed premature attenuation compared to hydrodynamic expectations. Optical streak records of the motion of internally placed mirrors show the actual shape of the shock pulse. The change in shape as well as the amplitude of the shock as it traverses the target can thus be studied and compared with theory. Examples of streak records at various depths in the target will be shown and discussed. Author

N68-12498# Southwest Research Inst., San Antonio, Tex.
PREPARATION OF LOW DENSITY SULFUR FOAM
John M. Dale and Allen C. Ludwig Hanover, N. H. CRREL Sep. 1967 18 p
(Contract DA-27-021-AMC-34(X))
(CRREL-TR-206; AD-661315)

Work was directed to the development in the laboratory of low density, rigid sulfur foam having acceptable thermal and permeation characteristics and sufficient structural strength for use in construction applications in the cold regions. The study involved the selection and screening of various additives, as well as the development of a process, techniques, and procedures which when applied to sulfur in a molten state in a pressurized vessel permit the extrusion of a molten froth which on cooling solidifies to a rigid low density foam. The most important single achievement was the reduction in the density of sulfur foam from 25 lb/cu ft to 10 lb/cu ft, which constitutes an improvement in the expansion ratio based on elemental sulfur from 1:5 to 1:12, while, at the same time, maintaining a uniform material having essentially a closed cell structure. The low density sulfur foam has proved to have attractive stress-strain, thermal conductivity, moisture absorption, and permeability characteristics. By reducing the density, the unit volume cost of the foam has been significantly reduced, further adding to the economic attractiveness of this material. TAB

N68-12516# Forest Products Lab., Madison, Wis.
COMPRESSIVE AND SHEAR PROPERTIES OF POLYESTER AND POLYIMIDE FILM HONEYCOMB CORE
Paul M. Jenkinson Oct. 1967 10 p ref
(Contract F33615-67-M-5001; Order IPR-19-7-8522)
(FPL-75; AD-661107)

Two types and three thicknesses of plastic film honeycomb core, as might be used in sandwich panels, were evaluated in compression and shear at room temperature. Author (TAB)

N68-12548# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
HIGH TEMPERATURE THERMAL CONDUCTIVITY OF BERYLLIUM OXIDE
D. L. Mc Donald and R. J. Dullow Aug. 1966 12 p refs
(AAEC/E-157)

The thermal conductivity of BeO samples produced by isopressing at 20 ton in^{-2} and sintering at 1505°C was measured at 360 to 1200°K. The BeO compacts measured had a density of 2.85 g cm^{-3} and an average grain size of 6μ. The thermal conductivity was found to be given by the relation $k = 1.01 \times 10^{4} T^{-1.47}$, where k is the thermal conductivity (watt (cm deg K)$^{-1}$) and T is the absolute temperature. This result is compared with other thermal conductivity measurements on similar materials. Author (NSA)

N68-12642# Sandia Corp., Albuquerque, N. Mex.
MOISTURE CONTENT DETERMINATION IN RIGID POLYURETHANE FOAMS
C. C. Thacker Sep. 1967 23 p refs
(Contract AT(29-1)-789)
(SC-DR-67-696) CFSTI: HC $3.00/MF $0.65

Data are presented to show that serious errors occur when the heat/vacuum method is used to determine the moisture content of rigid polyurethane foam. An instrument that eliminates these errors and provides a simple, accurate, and rapid means of determining water content is discussed. Results are derived from the data to show that no water is present in carefully processed rigid foam. Author (NSA)

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N68-11914# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
LINEAR PROGRAMMING METHODS FOR NUMERICAL SOLUTION OF DIFFERENT AL EQUATIONS [I METHODI DELLA PROGRAMMAZIONE LINEARE NELLA RISOLUZIONE NUMERICA DI EQUATIONI DIFFERENZIALI]
G. Toselli 1967 18 p refs In ITALIAN
(RT/FIMA/67/3) CFSTI: HC $3.00/MF $0.65

The numerical solution method is specifically described, and two problems are given to show the applicability of this technique. The first involves the numerical treatment of an ordinary linear differential equation. The second pertains to a boundary layer heat transfer problem wherein the temperature is determined in a mixed flow. Transl. by T.Z.D.

N68-11932*# Missouri Univ., Columbia. Research Center.
SOME EXTENSIONS OF THE KUHN–TUCKER RESULTS IN CONCAVE PROGRAMMING
James C. Moore 14 Aug. 1967 44 p refs Revised
(Grant NGR-26-004-012)
(NASA-CR-91076) CFSTI: $3.00 CSCL 12A

A systematic treatment is made of the theory of the constrained maximization of nondifferentiable vector valued functions defined on a finite dimensional Euclidean space. The nature of the constrain qualifications which have been used in this type of maximization problem are systematically explored. Both the geometric role which the constrain qualification plays in the problem and the relationships among the various constraint qualifications which have been used are examined. R.N.A.

N68-11937*# Maryland Univ., College Park. Computer Science Center.
SPECTRAL PROPERTIES OF MATRICES WHICH HAVE INVARIANT CONES
James S. Vandergraft Oct. 1967 26 p refs
(Grant NsG-398)
(NASA-CR-91059; TR-67-54) CFSTI: HC $3.00/MF $0.65 CSCL 12A

The Perron–Frobenius theory of non-negative matrices was found to be of great value in the study of iterative processes. In this paper, we extend much of this theory to include those matrices which leave invariant a closed convex cone with non-empty interior. Such matrices are completely characterized in terms of certain spectral properties. The notion of irreducibility is generalized to these matrices, and several theorems are proved to show that this is a suitable extension of the classical concept. The basic results of the Perron–Frobenius theory are then extended, and several useful comparison theorems for iterative processes are derived. Author

N68-11955# Purdue Univ., Lafayette, Ind. Dept. of Statistics.
ON THE RATE OF CONVERGENCE IN RENEWAL AND MARKOV RENEWAL PROCESSES
Jozef L. Teugels Jun. 1967 97 p refs *Its* Mimeograph Ser. No. 107
(Grant AF-AFOSR-955-65)
(AD-652492) CFSTI: HC $3.00/MF $0.65

For the special case of a distribution function that tends to one exponentially fast, the three basic renewal theorems are proved by the same method. Moreover an estimate of the remainder term is obtained. This extends results of M. R. Leadbetter. Series expansions are obtained for the renewal function by using matrix methods. Similar methods apply equally well to the Psi-renewal moments. Author (TAB)

N68-11959# Lincoln Lab., Mass. Inst. of Tech., Lexington.
THE GIVENS–HOUSEHOLDER METHOD FOR FINDING EIGENVALUES AND EIGENVECTORS OF REAL SYMMETRIC MATRICES
David C. Walden 26 Oct. 1967 38 p refs
(Contract AF 19(628)-5167)
(TN-1967-51; ESD-TR-67-549; AD-661277)

The report describes the Givens-Householder method for finding the eigenvalues and eigenvectors of a real symmetric matrix. An attempt has been made to describe the method with detail and clarity such that it becomes a method that is readily useful to a typical engineer or programmer. Author (TAB)

N68-11969# Research Triangle Inst., Durham, N. C.
RESEARCH IN SEQUENTIAL FACTORIAL DESIGNS Final Report, Dec. 1965–Jun. 1967
Sidney Addelman Wright-Patterson AFB, Ohio ARL Jul. 1967 42 p refs
(Contract AF 33(615)-3407)
(ARL-67-0141; AD-660570)

This report is concerned with an investigation of sequences of fractional replicate plans for from three to seventeen two-level factors. Sequences of distinct and non distinct factorial replicate plans from single and multiple families of defining contrasts are compared. The sequences are then categorized according to the lengths of the interactions in the defining contrasts at various stages of the sequence. A set of generators is presented for the defining contrasts of the smallest fractional replicate plan in each sequence. Author (TAB)

N68-12011* Alabama Univ., University. Mathematics Dept.
THE DEVELOPMENT OF MARKOV CHAIN PROCEDURES FOR SPACE GUIDANCE AND NAVIGATION PROCEDURES Technical Report, Sep. 1966–Aug. 1967
O. R. Ainsworth and James W. Steincamp Aug. 1967 121 p refs
(Contract NAS8-18000)
(NASA-CR-91041; DCN-1-6-40-68250 (1F)) CFSTI: $3.00 CSCL 12A

Stochastic processes are classified according to the nature of their state spaces and index sets, and the concept of dependence relations is considered. A Markov process is described by a transition probability function, and Markov chains are studied in relation to the problem of determining their parameter-dependent or transient behavior, i.e., determining the probability transition function by finding and solving the equations which they satisfy. Several examples are given. The Erdos–Feller–Pollard theorem is formulated, and its applications are discussed. Consideration is also given to taboo probabilities, ratio theorems, R-regular vectors, and the sums of independent random variables as Markov chains. Several algorithms for computing the generalized inverse are given, and a necessary and sufficient condition that one matrix polynomial shall be divisible by another is obtained. The generalized inverse is applied to solving systems of linear equations, and to problems of polynomial approximation and multilinear regression. Lemmas and theorems pertaining to generalized similarity relations are presented. M.G.J.

N68-12027# Stanford Univ., Calif. Dept. of Computer Science.
CALCULATION OF GAUSS QUADRATURE RULES
Gene H. Golub and John H. Welsch 3 Nov. 1967 31 p refs Sponsored in part by ONR, NSF, and AEC
(CS-81; AD-661217)

Most numerical integration techniques consist of approximating the integrand by a polynomial in a region or regions and then integrating the polynomial exactly. Often a complicated integrand can be factored into a non-negative weight function and another function better approximated by a polynomial, thus the integral from a to b of (g(t) dt) = the integral from a to b of (omega (t) f (t) dt) which approximately equals summation, i =1 to i = N, of (w sub i f(t sub i)). Hopefully, the quadrature rule (w sub j, t sub j) subscript j = 1, superscript N corresponding to the weight function omega(t) is available in tabulated form, but more likely it is not. We present here two algorithms for generating the Gaussian quadrature rule defined by the weight function when: (a) the three term recurrence relation is known for the orthogonal polynomials generated by omega(t), and (b) the moments of the weight function are known or can be calculated. Author (TAB)

N68-12033# RAND Corp., Santa Monica, Calif.
GRAPHS WITH MONOCHROMATIC COMPLETE SUBGRAPHS IN EVERY EDGE COLORING
John Folkman Oct. 1967 17 p
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5348-PR; AD-661258)

The report contains an investigation of a class of graphs G with the property that if the edges of G are colored red and blue, then either G contains r mutually adjacent vertices with all connecting lines colored red or s mutually adjacent vertices with all connecting lines colored blue. The study concerns the maximum number of mutually adjacent vertices that such a graph must have and shows that there exist graphs with only max(r, s) mutually adjacent vertices. Author (TAB)

N68-12035# Stanford Univ., Calif. Dept. of Statistics.
CONVERGENCE RATES FOR EMPIRICAL BAYES TWO-ACTION PROBLEMS. 2: CONTINUOUS CASE
M. V. Johns, Jr. and J. Van Ryzin 20 Nov. 1967 31 p refs
(Contract Nonr-225(62); Grant PHS-GM-14554-01)
(TR-132; AD-661251)

A sequence of decision problems is considered where for each problem the observation has a probability density function of exponential type with parameter lambda where lambda is selected independently for each problem according to an unknown prior distribution G(lambda). It is supposed that in each of the problems, one of two possible actions (e.g., accept or reject) must be taken. Under various assumptions, reasonably sharp upper bounds are found for the rate at which the risk of the nth problem approaches the smallest possible risk for certain refinements of the standard empirical Bayes procedures. For suitably chosen procedures, under situations likely to occur in practice, rates faster than n to the power (-1 + epsilon) may be obtained for arbitrarily small epsilon > 0. Arbitrarily slow rates can occur in pathological situations. Author (TAB)

N68-12041# RAND Corp., Santa Monica, Calif.
AN APPRAISAL OF SOME SHORTEST PATH ALGORITHMS
S. E. Dreyfus Oct. 1967 40 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5433-PR; AD-661265)

A critical review of the literature of shortest paths in networks that examines methods for determining (1) the shortest path between two specified nodes; (2) the shortest path between all pairs of nodes; (3) the second, third, etc., shortest path; (4) the fastest path through a network with travel times depending on the departure time; and (5) the shortest path between specified endpoints that passes through specified intermediate nodes. Inefficient algorithms, erroneous procedures, and false assumptions in the current literature are identified. Author (TAB)

N68-12071# Florida State Univ., Tallahassee. Dept. of Statistics.
SURVEILLANCE PROBLEMS: A PROGRAM FOR OBTAINING OPTIMAL COSTLY SURVEILLANCE STRATEGIES FOR A POISSON PRODUCTION PROCESS
C. Bradley Russell Sep. 1967 35 p refs
(Contract Nonr-988(13))
(FSU-M125; AD-661198)

A computer program is presented to obtain an optimal strategy in the class of non-randomized stationary strategies for controlling a Poisson production process under costly surveillance when the income function is a polynomial whose final coefficient is negative. Earlier results of the author show that under an assumption of monotonicity of the income function, an optimal strategy in this class is optimal over the class of all strategies. Flowcharts describing the program, a Fortran IV version of the program, and examples are given. Author (TAB)

N68-12072# Florida State Univ., Tallahassee. Dept. of Statistics.
APPROXIMATE SMALL-SAMPLE DISTRIBUTIONS FOR MULTIVARIATE TWO-SAMPLE NONPARAMETRIC TESTS
Kantilal M. Patel and Ralph A. Bradley Nov. 1967 21 p refs
(Contract Nonr-988(08))
(FSU-M128; ONR-TR-25; AD-661199)

There has been much recent interest in multivariate, nonparametric procedures with major emphasis on their asymptotic properties. The multivariate, two-sample problem is considered in this paper with particular interest in small-sample applications. The construction of useful tables seems precluded because of inherent correlations between variates and hence approximate test procedures are developed that are based on exact, small-sample moments. The tests considered are the multivariate randomization test, the multivariate rank test, and the multivariate normal scores test. Examples are given. Author (TAB)

N68-12207# California Inst. of Tech., Pasadena.
A SEARCH FOR SIMPLE GROUPS OF ORDERS LESS THAN ONE MILLION
Marshall Hall, Jr. 1967 62 p refs
(Contract N00014-67-A-0094-0010; Grant NSF GP-3909)
(AD-660717)

In 1900 L. E. Dickson listed 53 known simple groups of composite order less than one million. Three more groups have been added to this list since that time. A group of order 29120 was discovered by M. Suzuki in 1960, the first of an infinite class, and one of order 175,560 was discovered by Z. Janko in 1965 which appears to be isolated. Very recently Z. Janko announced that a simple group with certain properties would have order 604,800 and have a specific character table. The construction of a simple group of order 604,800 is given for the first time in this paper. TAB

N68-12226# RAND Corp., Santa Monica, Calif.
FITTING FUNCTIONAL EQUATIONS TO EXPERIMENTAL DATA
H. Kagiwada and R. Kalaba Oct. 1967 9 p refs Presented at the Hawaii Intern. Conf. on System Sci. Honolulu, 29–31 Jan. 1968
(P-3703; AD-660553)

Much of mathematical analysis is devoted to the problem of predicting the future behavior of a system, given a descriptive equation and the current state. This is surprising since a basic scientific problem in such fields as physics, engineering, biology and economics is that of determining the structure of a system, given various observations over time. Many types of functional equations may be converted into systems of ordinary differential equations. This means that wide classes of direct problems can be solved as initial-value problems. This also means that a great many inverse problems may be computationally resolved. Let the equations which describe a particular process be a system of differential equations. The unknown structure of the process is reflected in unknown system parameters which appear in the differential equations or in the initial conditions. These parameters are to be estimated on the basis of observations of the process. The identification problem takes the form of a nonlinear boundary-value problem. This can be solved by a variety of methods. One that has been shown to be quite effective is described in this report. TAB

N68-12235# Stanford Univ., Calif. Dept. of Statistics.
MEASURES OF GLOBAL RELATIVE CURVATURE
Paul I. Feder 20 Oct. 1967 26 p refs
(Contract Nonr-225(52))
(TR-129; AD-660682)

The descriptive problem is considered in determining to what extent a convex regression function appears to have smooth change in slope rather than abrupt changes as typified by broken lines. An index of relative curvature is defined which assigns large values to functions having smooth first derivative and which is zero for broken lines. Discrete approximations to this index are considered, depending only on knowledge of the regression function at a finite set of points. Values of these indices are calculated for convex functions obtained from least squares regression fits in

models having only the restriction of concavity. A Monte Carlo experiment was conducted to determine the variability of these discrete indices and some numerical results are presented. Author (TAB)

N68-12264# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
ON ONE TYPE OF SINGULAR INTEGRAL EQUATIONS
G. S. Litvinchuk and E. G. Khasabov 9 Feb. 1967 26 p refs Transl. into ENGLISH from Sibirskii Mat. Zh. (Moscow), v. 5, no. 3, 1964 p 608–625
(Contract NOw-62-0604-c)
(TG-230-T510; AD-661212)

The integral equation a(t) (phi (t) bar) + b(t)/pii multiplied by the integral over L of the quantity (phi(tau)/tau-alpha(t)) d(tau) = c(t) is considered, where a(t), c(t) satisfy Holders condition on the closed Ljapunov contour L. It is assumed that a(t) and b(t) do not vanish on L. The function alpha(t) is a homeomorphic (direction-preserving) mapping of L upon itself, alpha prime (t) does not equal zero on L and satisfies Holders condition on L. Under the additional hypotheses that alpha(alpha(t)) = t on L and a(t) a(alpha(t)) = b(t) b(alpha(t)) on L, the author gives a qualitative analysis of the given integral equation. The number of linearly independent solutions of the homogeneous equation corresponding to (1) is found, and an algorithm is derived for finding these solutions. Conditions for the solvability of Eq. (1) are determined. On the basis of these results the normal solvability and the vanishing of the index of the given integral equation are established. Cases are presented when the given equation can be solved in closed form. TAB

N68-12287# Illinois Univ., Urbana.
THEOREMS ABOUT BEURLING'S GENERALIZED PRIMES AND THE ASSOCIATED ZETA FUNCTION
Richard S. Hall Jun. 1967 77 p refs
(Contract Nonr-1834(18))
(TR-17; AD-661238)

Beurling defined a set, P, of generalized prime numbers as any non-decreasing unbounded sequence of real numbers which are greater than one. The multiplicative semi-group, N, generated by the elements of P is called the associated set of generalized integers. The functions Pi (x) and N (x) are defined, respectively, as the number of generalized prime and integers less than or equal to x. This paper is concerned with deducing the behaviour of Pi (x) from that of N (x). TAB

N68-12291# Stanford Univ., Calif. Dept. of Statistics.
SOME ESTIMATION PROBLEMS RELATED TO A GEOMETRIC DISTRIBUTION AND A SUM OF TWO INDEPENDENT NONIDENTICALLY DISTRIBUTED RANDOM VARIABLES
Stanley L. Sclove and John Van Ryzin 30 Oct. 1967 46 p refs
(Contract Nonr-225(52))
(TR-130; AD-660684)

The problem of estimating the parameters of a linear function of a geometrically distributed random variable is considered. Then this problem is complicated by assuming that the observations contain additive normal noise. This leads to consideration of the more general problem of estimating the parameters of the distribution of the sum of two independent random variables having distributions from different families. The focus throughout the report is on the method of moments. Author (TAB)

N68-12292# Stanford Univ., Calif. Dept. of Statistics.
CONVERGENCE RATES FOR EMPIRICAL BAYES TWO-ACTION PROBLEMS 1. DISCRETE CASE
M. V. Johns, Jr. and J. Van Ryzin 13 Nov. 1967 41 p refs
(Contract Nonr-225(52); Grant PHS-GM-14554-01)
(TR-131; AD-661250)

A sequence of decision problems is considered where for each problem the observation has discrete probability function of the form p(x) = h(x) beta (lambda) lambda to the power x, x = 0,1,2,.... and where lambda is selected independently for each problem according to an unknown prior distribution G(lambda). It is supposed that for each problem one of two possible actions (e.g., accept or reject) must be selected. Under various assumptions about h(x) and G(lambda) the rate at which the risk of the nth problem approaches the smallest possible risk is determined for standard empirical Bayes procedures. It is shown that for most practical situations, the rate of convergence to optimality will be at least as fast as L(n)/n where L(n) is a slowly varying function (e.g., log n). The rate cannot be faster than 1/n and this exact rate is achieved in some cases. Arbitrarily slow rates will occur in certain pathological situations. Author (TAB)

N68-12412# Iowa State Univ. of Science and Technology, Ames.
ELLIPTIC INTEGRALS OF THE THIRD KIND
Dennis Gene Zill (Ph.D. Thesis) May 1967 102 p refs
(Contract W-7405-ENG-82)
(IS-T-143) CFSTI: HC $3.00/MF $0.65

Two functions $R_J(x,y,z,\rho)$ and $R_H(x,y,z,\rho)$, which are partially symmetric homogeneous hypergeometric functions, are considered. Either one of these functions can serve as a replacement for Legendre's normal elliptic integral of the third kind. The complete symmetry of $R_{J,H}(x,y,z,\rho)$ in x,y,z is shown to obviate the linear transformations, in Legendre's notation, on the amplitude ϕ and modulus k. Also, the linear transformations involving the parameter α^2, the so-called change-of-parameter relations, are derived. An additional and apparently new transformation is obtained. The interchange theorem as well as the theorem on addition of amplitudes is rephrased in the new notation. The addition theorem yields a duplication formula which is useful in numerical evaluation of R_J and R_H. Since symmetry in three arguments supersedes a set of linear transformations, it was not unexpected that in this new formulation the quadratic Landen and Gauss transformations assume a unified form. Iterative use of these transformations provides a method for numerical evaluation of the functions. Two suprisingly elegant computational algorithms for R_J, based on the descending Gauss and ascending Landen transformations, are derived. Another procedure for calculating R_J based on an infinite series, is also considered. Some inequalities for R_J are examined which are illustrated by several numerical examples. Three appendices contain a table of reduction formulas, numerical tables of R_J and R_H, and two Fortran programs. Author (NSA)

N68-12451# Wisconsin Univ., Madison. Mathematics Research Center.
RELATIONS BETWEEN DERIVATIVES
J. G. van der Corput Aug. 1966 30 p
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-632; AD-660499)

If x = a + ((xi-alpha) to the power tau) chi(xi), where r tau is a positive integer and where chi(xi) is not equal to zero and analytic at xi = alpha, then the derivatives with respect to x at the point x = a can be expressed by means of the derivatives with respect to xi at the point xi = alpha. This problem and the corresponding problems for an arbitrary number of variables is treated, leading to generalizations of the formula of Lagrange-Burmann. Author (TAB)

N68-12529# Iowa State Univ. of Science and Technology, Ames.
PRECISE EIGENVECTOR BASIS FOR A SYMMETRIC MATRIX

Richard Frank Sincovec (M.S. Thesis) May 1967 53 p refs
(Contract W-7405-ENG-82)
(IS-T-167) CFSTI: HC $3.00/MF $0.65

A new theorem is proved to the effect that if a rank-one matrix of the form $\bar{x}\,\bar{x}'$, where $\bar{x}$ is a column vector and $\bar{x}'$ is its transpose, commutes with a symmetric matrix A, then x is an eigenvector of A. This fact enables one to compute an eigenvector with nearly the precision of the computer by the following algorithm: Define $R_0 = A\,\bar{x}_0\bar{x}_0' - \bar{x}_0\bar{x}_0'A$ where $\bar{x}_0$ is an arbitrary non-zero vector. Define $\bar{x}_1 = \bar{x}_0 + t_0\bar{g}_0$ where g_0 is an appropriately chosen change vector and t_0 is an optimum parameter so that the matrix $R_1 = A\bar{x}_1\bar{x}_1' - \bar{x}_1\bar{x}_1'A$ has a smaller norm than R_0. This procedure is continued iteratively until a residual matrix R_m is found with norm sufficiently close to zero. Then the corresponding vector $\bar{x}_m$ is taken as the eigenvector. A systematic procedure for choosing the change vectors $\bar{g}_m$ is devised and a procedure for finding all the eigenvectors is developed. An analysis is made which gives the necessary and sufficient conditions that an eigenvector of the given matrix must satisfy with respect to the iterative procedures. Also it is proved that the iterative procedure is convergent and that the sequence of eigenvector approximations does not converge to the zero vector. An example is given to illustrate the proposed method.
Author (NSA)

N68-12581# Atomics International, Canoga Park, Calif.
PCSQ: A SUBROUTINE FOR DETERMINING THE CHI-SQUARE PROBABILITY
L. S. Beller 8 Nov. 1966 17 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-MEMO-12235) CFSTI: HC $3.00/MF $0.65

This memo describes a subroutine computer program to assist in performance of the χ^2-test. Given χ^2 and the number of degrees of freedom, the routine finds the corresponding probability, P, by a table-look-up procedure. The necessary user information, listings and examples of use are given. Author (NSA)

N68-12604# General Dynamics Corp., San Diego, Calif. General Atomic Div.
ON STABLE METHODS OF MATRIX FACTORIZATION FOR BLOCK-TRI-DIAGONAL MATRICES. PART 1: GENERAL METHODS AND THEOREMS
Reimar Froehlich 31 Oct. 1966 26 p refs
(Contract AT(04-3)-167)
(GA-7164, Pt. 1) CFSTI: HC $3.00/MF $0.65

For the solution of a system of linear equations with a block-tri-diagonal coefficient matrix the method most widely in use is a direct generalization of the forward elimination–backward substitution method for tri-diagonal matrices. The matrix elements are simply replaced by block-submatrices. If the block-submatrices are all of the same order the reconditioning method, also known as the stabilized march out technique, has been proposed for some applications. Both methods are described and discussed quite generally. Necessary and sufficient conditions for the applicability of both methods, the conventional forward elimination–backward substitution method and the reconditioning method, are derived. Moreover, it is proved that the forward elimination–backward substitution method for block-tri-diagonal matrices is a special case of the reconditioning method. Finally, two iterative improvement techniques for the solution of linear equations and matrix inversions are discussed, and sufficient convergence conditions are derived.
Author (NSA)

N68-12609# Oak Ridge National Lab., Tenn. Health Physics Div.
DIFFERENTIABILITY OF SET FUNCTIONS
H. A. Wright (Ph.D. Thesis—Tenn. Univ., Knoxville) and W. S. Snyder Oct. 1967 61 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1952) CFSTI: HC $3.00/MF $0.65

Various properties of the upper and lower (F,α) derivates and of the (F,α) derivative of an arbitrary real and finite-valued function defined on the sets of a family F of measurable subsets of Euclidean n-space R_n, where α is a real number such that $0<\alpha<1$, are evaluated. Properties discussed include measurability, finiteness, boundedness, existence of the derivative, and summability. A discussion of the historical background of the subject and definitions and basic concepts is included. NSA

N68-12641# New York Univ., N. Y. Courant Inst. of Mathematical Sciences.
NUMERICAL ANALYSIS OF BOUNDARY LAYER PROBLEMS
William D. Murphy Aug. 1966 148 p refs
(Contract AT(30-1)-1480)
(NYO-1480-63) CFSTI: HC $3.00/MF $0.65

Some of the finite difference methods that can be used to treat the initial value problem for the boundary layer differential equation $\mu y'' = f(y,x)$ are categorized. A new kind of stability called μ-stability is defined and it is proven that under certain conditions μ-stability implies convergence of the difference method. The μ-stability and the optimal methods which it allows, i.e., methods of maximum accuracy, are investigated. These results are generalized to the vector case. Also considered are the related finite difference methods for the initial value problem $\mu y'' = f(y,z,x)$, $z' = g(y,z,x)$. To illustrate the theoretical results, a number of problems were solved by these methods with the use of the CDC 6600 and IBM 7094 computers. Author

N68-12673# Sandia Corp., Albuquerque, N. Mex.
USE OF THE KOLMOGOROV–SMIRNOV STATISTIC TO VALIDATE SUPPLIERS' INSPECTION RESULTS
Roger W. Berger Feb. 1967 23 p refs
(Contract AT(29-1)-789)
(SC-TM-66-813) CFSTI: HC $3.00/MF $0.65

The application of nonparametric techniques to the problem of validating suppliers' variables-type inspection results is summarized. Because of its desirable mathematical properties, ease of application, and freedom from restrictive assumptions, the Kolmogorov–Smirnov statistic is used. By exact and approximate equations, tables of significance probabilities are extended and placed in different order for ease of application. Properties of the test and techniques for calculating probabilities are discussed. Author (NSA)

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N68-11922# Massachusetts Inst. of Tech., Cambridge. Flight Transportation Lab.
WEATHER CONDITIONS AFFECTING VTOL AIRBUS OPERATIONS IN THE NORTHEAST CORRIDOR
Robert W. Simpson Dec. 1966 44 p refs
(Contracts C-136-66; C-85-65)
(TR-FT-66-4; PB-174915) CFSTI: HC $3.00/MF $0.65

A detailed study of hourly weather observations in the Northeast Corridor during the periods 0600–2400 for a ten year period 1944–1958 was made to study the implications of weather affecting the operations of a VSTOL Airbus transportation system. As a result, specifications for an automatic approach to a hover ending at 75 feet above ground, and within 350 feet visibility were determined to achieve weather reliable operations of over 99.5% throughout the year. Examination of high temperatures indicated that a criterion of operation at 95°F at 1000 feet elevation should

be used to ensure 99.5% reliability through the summer months over the corridor. The frequency of high winds indicated that a step gust of 30 mph could be used for specifying the aircraft's displacement from a hover position while under an inertially stabilized automatic control system. The study indicates that Category II all weather operations occur about 0.9% of the time, and Category III about 1.3% of the time in the Northeast Corridor. Author

N68-11923# National Severe Storms Lab., Norman, Okla.
THUNDERSTORM CIRCULATIONS AND TURBULENCE STUDIES FROM AIRCRAFT AND RADAR DATA
James C. Fankhauser and J. T. Lee Apr. 1967 36 p refs
(IERTM-NSSL-32; PB-174860) CFSTI: HC $3.00/MF $0.65

There are 2 reports included under this cover: "Association Between Atmospheric Turbulence and Radar Echoes in Oklahoma" by J. T. Lee, and "Some Physical and Dynamical Aspects of a Severe Right Moving Cumulonimbus" by J. C. Fankhauser. Author

N68-11945# National Meteorological Center, Suitland, Md.
OBJECTIVE NUMERICAL PREDICTION OUT TO SIX DAYS USING THE PRIMITIVE EQUATION MODEL—A TEST CASE
A. James Wagner May 1967 23 p refs
(WBTM-NMC-TM-39; PB-174920) CFSTI: HC $3.00/MF $0.65

The report is a brief summary of the results of a test case study using the primitive equations to make numerical predictions out to six days after the initial time. Daily and selected 5-day mean charts of 500-, 700-, and 1000-mb. height and 1000 to 500- and 1000 to 700-mb. thickness, along with their departures from normal, were produced directly from the model. For comparison, the barotropic 500-mb. forecast heights were also obtained, and both primitive and barotropic forecasts were compared with the observed heights and thicknesses. Author

N68-11947 Freie Univ., Berlin (West Germany). Institut fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 74, NO. 7: DAILY AND MEAN SURFACE AND 850-MB MAPS OF THE NORTHERN HEMISPHERE IN JULY 1967 [METEOROLOGISCHE ABHANDLUNGEN. BAND 74, NO. 7: TAEGLICHE UND MITTLERE BODEN- UND 850-MB-KARTEN DER NORDHEMISPHAERE IMJAHRE 1967-JULI]
Manfred Geb, Richard Scherhag et al 1968 85 p In GERMAN

Presented are the daily and mean monthly weather charts for the Northern Hemisphere during July, 1967. Measured were atmospheric pressures, circulation, and air temperatures at 850 mb, as well as ground temperatures and precipitation accumulations. Transl. by G.G.

N68-11965# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
ACOUSTIC MEASUREMENT OF SUPERSATURATION IN A WARM CLOUD
Richard D. H. Low Aug. 1967 24 p refs
(ECOM-5146; AD-661078)

The degree of supersaturation in a natural cloud is usually estimated by noting the updraft, or in a cloud chamber, by means of the adiabatic expansion or vapor pressure curve. No instrument is in existence at this time for a direct measurement. This paper proposes an acoustic approach whereby the degree of supersaturation may be determined in a warm cloud, limited only by the sophistication of the associated electronic equipment. Author (TAB)

N68-12018# Emmanuel Coll., Boston, Mass. Oriental Science Library.
PROBABILITIES OF THE STOCHASTIC VARIATIONS OF WET AND DRY DAYS
Yao Ch'en-sheng Bedford, Mass. AF Cambridge Res. Labs. Sep. 1967 24 p refs Transl. into ENGLISH from Ch'i Hsiang Hsueh Pao (Peking), v. 36, no. 2, Jun. 1966 p 249–260
(Contract AF 19(628)-5073)
(EMM-67-156; AD-660538)

In the paper, the probabilities of the stochastic variations of wet and dry days are evaluated by means of regular Markov chains. The computed results are found to be useful in supplementing single-station forecasts. A recursion formula of high order transition probabilities is also derived directly from conditional probabilities and the computed results from this formula are concordant with those calculated from Markov chains. In addition, it is shown that a formula for determining the sampling values of high order transition probabilities may be obtained from the above recursion formula. These values are found to be useful in determining the adequacy of the computed results from Markov chains in representing the observed situations. Author (TAB)

N68-12020# Massachusetts Inst. of Tech., Cambridge. Meteorology Dept.
ROUND HILL TURBULENCE MEASUREMENTS. VOLUME 3: DATA TABULATIONS FOR RUNS 32 THROUGH 66D
H. E. Cramer, F. A. Record, and J. E. Tillman Dec. 1966 295 p
(Grant DA-AMC-28-043-65-G10)
(ECOM-65-G10, V. 3; AD-661035)

The volume contains the data summaries for runs 32 through 66D. Vertical profiles of mean wind speed, air temperature, and soil temperature are presented in Section I. Section I also includes estimates of terms of the heat-budget equation. Turbulence statistics are presented in Section II. For a description of the field experiments and the data-processing procedures, reference should be made to Volume I (AD-661 033) of this series. Author (TAB)

N68-12049 Freie Univ., Berlin (West Germany). Institut fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 76, NO. 7: RESULTS OF THE ASCENTS OF THE RADIOSONDE STATION BERLIN-TEMPELHOF OF THE FREIE UNIVERSITAET BERLIN IN THE YEAR 1967, JULY [METEOROLOGISCHE ABHANDLUNGEN. BAND 76, HEFT 7: ERGEBNISSE DER AUFSTIEGE DER RADIOSONDENSTATION BERLIN-TEMPELHOF DES INSTITUTS FUER METEOROLOGIE UND GEOPHYSIK DER FREIEN UNIVERSITAET BERLIN IMJAHRE 1967, JULI]
Richard Scherhag et al 1968 97 p refs In GERMAN; ENGLISH summary
CFSTI: $3.00

The detailed results of the radiosonde ascents performed by the serological station of the Institute for Meteorology and Geophysics of the Free University of Berlin are presented. Extreme and mean values of the temperature, geopotential, pressure, wind data, refractivity, density, pseudopotential temperature and velocity of sound for all standard pressure surfaces and for several height levels, the tropopause and the freezing level were extracted. Author

N68-12050 Freie Univ., Berlin (West Germany). Institut fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 76, NO. 6: RESULTS OF THE ASCENTS OF THE RADIOSONDE STATION BERLIN-TEMPELHOF OF THE INSTITUT FUER METEOROLOGIE UND GEOPHYSIK OF THE FREIE UNIVERSITAET BERLIN IN THE YEAR 1967, JUNE [METEOROLOGISCHE ABHANDLUNGEN. BAND 76, NO. 6: ERGEBNISSE DER AUFSTIEGE DER RADIOSONDENSTATION BERLIN-TEMPELHOF DES INSTITUTS FUER METEOROLOGIE UND GEOPHYSIK DER FREIEN UNIVERSTITAET BERLIN IM JAHRE 1967, JUNI]
Richard Scherag et al 1968 86 p In GERMAN
CFSTI: $3.00

The detailed results of the radiosonde ascents performed by the aerological station of the institute for meteorology and geophysics of the free university aerological station of the Institute for Meteorologie and Geophysics of the Free University of Berlin are presented. Extreme and mean values of the temperature, geopotential, pressure, wind data, refractivity, density, pseudopotential temperature and velocity of sound for all standard pressure surfaces and for several height levels, the tropopause and the freezing level were extracted. Author

N68-12063# Massachusetts Inst. of Tech., Cambridge. Dept. of Meteorology.
SMALL SCALE VELOCITY STRUCTURE IN THE 30–60 KM. REGION DEDUCED FROM PAIRED ROBIN SOUNDINGS
James R. Mahoney and George J. Boer, Jr. 31 Mar. 1967 67 p refs
(Contract AF 19(628)-5075)
(AFCRL-67-0263; SR-1; AD-661286)

The report gives a brief description of the apparatus and data gathering techniques used in the falling-sphere experiment performed at the White Sands Missile Range on March 6, 1965. A method of obtaining smoothed velocity profiles from the raw radar position coordinates is presented and an analysis of radar error in the velocity profiles, made possible by the double radar coverage obtained for the experiment, is given. The study involves a statistical analysis of means, variances, and correlation coefficients for various smoothings and altitude bands. Auto-correlations in the vertical are presented indicating the behaviour with smoothing and permitting an estimate of vertical scale of the motions. The decay of the cross-correlation coefficient between soundings is obtained to permit an estimate of horizontal scale. The results are interpreted and suggestions for further work are presented. TAB

N68-12079# Emmanuel Coll., Boston, Mass. Research Language Center.
AN EXPERIMENT ON THE ELECTRIFICATION AND GROWTH OF FROST NEEDLES ON THE SURFACE OF FROZEN WATER DROPS IN AN ELECTRIC FIELD
Xiao-ping Cheng, Chen Qian, and Yu-ren Xia Bedford, Mass. AFCRL Sep. 1967 14 p refs Transl. into ENGLISH from Ch'i Hsiang Hsueh Pao (Peking), v. 36, no. 2, Jun. 1966 p 231–236
(Contract AF 19(628)-5073)
(EMM-67-163; AD-660540)

The paper describes an experiment on the electrification of frost needles during their processes of growth on the surface of frozen water drops in an electric field. The intensity of electrification is found to vary between 0.10 and .01 e.s.u., which is one order of magnitude higher than that generated by the freezing of water drops. The production of such an enormous amount of static charge is considered highly significant in the study of the electrification mechanism within a thundercloud. Author (TAB)

N68-12080# Emmanuel Coll., Boston, Mass. Research Language Center.
THE METEOROLOGICAL RADAR EQUATION FOR THE COHERENT SCATTERING OF RADAR WAVES BY CLOUD DROPLETS AND RAINDROPS
Chi-chen Lee Bedford, Mass. AFCRL Sep. 1967 24 p refs Transl. into ENGLISH from Ch'i Hsiang Hsueh Pao (Peking), v. 32, no. 2, Jun. 1966 p 117–128
(Contract AF 19(628)-5073)
(EMM-67-159; AD-660539)

A general meteorological radar equation is derived from studies on the coherent scattering of radar waves by cloud droplets and raindrops. The conventional meteorological radar equation is a special form of this new derivation by neglecting the effect of coherent scattering. From a discussion of several aspects of the new equation, it is noted that the commonly observed discrepancy between computed results from the conventional equation and experimental evidence may be due to the negligence of the effect of coherent scattering. Author (TAB)

N68-12159 Freie Univ. (West Germany). Institut fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 74, NO. 4: THE INFLUENCE OF CITIES ON THE WORLDWIDE TEMPERATURE TREND [METEOROLOGISCHE ABHANDLUNGEN. BAND 74, NO. 4: DER STADTEINFLUSS AUF DEN WELTWEITEN TEMPERATURTREND]
Horst Dronia 1967 78 p refs In GERMAN; ENGLISH summary
CFSTI: $3.00

In the first method, non-influenced and city series are compared by computing the single differences of these stations. Sixty-seven of such pairs, spread over the world, gave an average city influence of +0.24°C for the 40-year period from 1901/10 to 1941/50. At the beginning and prior to this period, however, it had been higher; thus the increase for the period 1871/80 to 1951/60 reaches +0.7°C. When the measured magnitude of world-wide warming is reduced to an extent proportional to the share of cities in long-period series, there remains a slight cooling of −0.2°C. When the global temperature trend is arranged in two individual series comprising stations situated in cities and in the open country, the trend of the cities is warmer to the same degree as it was calculated for the mean effect resulting from the growth of cities. The world-wide trend since 1871/80 computed only from non-influenced stations and some reduced city stations agrees with the above findings. Indications are that after a short rise, the temperature has fallen about 0.2°C since 1871/80; this is 0.4°C below the value heretofore accepted as valid. Thus, the world-wide warming is narrowed down to a short episode of two or three decades and a value not hither than +0.25°C. Even if the first ten years with the strongest cooling and the smallest number of stations are excluded, the present temperature is the same as 80 years ago. K.W.

N68-12213# Weather Squadron (35th), Detachment 5, Paine Field, Wash.
PAINE FIELD TERMINAL FORECAST REFERENCE FILE
Arthur T. Safford, III Jun. 1967 351 p
(AD-661282)

An attempt is made to provide a forecaster arriving at Paine Field with some guidelines for forecasting in an area where only sparse data are available upstream. The report includes enough information to assist forecasters in daily operational forecasting, seminars on seasonal weather, and training for newly assigned forecasters. The first section deals with topics that help create the synoptic conditions experienced in the Pacific Northwest. The second part includes a classification of storm types plus four excellent case studies done at the University of Washington Department of Meteorology and adapted for operational forecasting

at this station. They serve as both actual synoptic developments and guidelines for accomplishing other objective case studies. The third part handles all aspects of forecasting at Paine Field and includes a series of objective case studies. Also included in this section are station forecast studies with precise description and judgment of practical forecasting use. TAB

N68-12222# Emmanuel Coll., Boston, Mass. Research Language Center.

PROBLEMS ON THE GEOGRAPHICAL DISTRIBUTION OF THE ATMOSPHERIC ELECTRIC FIELD INDUCED BY THUNDERSTORM ACTIVITIES

Chi-chen Lee and Chi-Zhang Bedford, Mass. AFCRL Sep. 1967 13 p refs Transl. into ENGLISH from Ch'i Hsiang Hsueh Pao (Peking), v. 36, no. 2, Jun. 1966 p 275–279
(Contract AF 19(628)-5073)
(EMM-67-165; AD-660541)

In the paper, the electromagnetic equation in spherical coordinates is first derived with due consideration on the actual electrical conductivity of the atmosphere and the correct selection of conditions for solution. The distribution of the atmospheric electric field induced by thunderstorm activities is then evaluated. Author (TAB)

N68-12248# Weather Squadron (12th), Detachment 43, Custer AFB, Mich.

PITTSBURGH VISIBILITY STUDY

Bernard J. Newhouse Oct. 1967 9 p
(AD-661279)

An effort has been made to improve forecasts of visibility near sunrise at Pittsburgh. A correlation of several parameters with the later occurrence of low visibilities (less than three miles) was attempted. The only significant correlation noted was that between visibility and wind speed as measured about four hours before sunrise. A graph showing occasions when low visibility should be forecast is presented. Using this graph the test of a years independent data gave a skill score of 0.52 with 84% correct forecasts. Author (TAB)

N68-12249# Weather Wing (1st), San Francisco, Calif. Scientific Services. 96525.

CLIMATOLOGY OF SIGNIFICANT WEATHER AT MACTAN AB, PHILIPPINES Final Report

Gary D. Atkinson Oct. 1967 15 p refs *Its* Tech. Study No. 13
(AD-661278)

The climatology of significant weather at Mactan is presented in graphical and table form. Significant weather is defined as: the occurrence of thunderstorms, ceiling/visibility conditions below VFR, surface wind gusts greater than or equal to 20 knots, and or rainfall. Observations for a limited period at Mactan are compared with a 10 to 15 year summary of observations at Cebu. There appears to be no significant climatic differences between the two locations. A screening of predictors to forecast thunderstorms at Mactan indicates that low level wind speed gives the best indication of thunderstorm probability (thunderstorms much more likely with light winds). Author (TAB)

N68-12271 Joint Publications Research Service, Washington, D. C.

QUANTITATIVE ESTIMATE OF ARTIFICIAL INCREASE OF PRECIPITATION IN THE COLD HALF OF THE YEAR IN THE UKRAINIAN STEPPE

M. P. Leonov 4 Dec. 1967 10 p refs Transl. into ENGLISH from Tr. Ukr. Nauchn. Issled. Gidrometeorologicheskogo Inst., (Leningrad), no. 61, 1966 p 81–85
(JPRS-43549) CFSTI: $3.00

With the intensification of precipitation in the cold half of the year it was discovered that the relative degree of its artificial increment is dependent on the semidiurnal sums of natural precipitation: it increases with an increase of the latter. On the basis of this dependence, established using experimental data, and also on the basis of the frequency of recurrence of precipitation of different intensity in this region, the author has computed the possible effect of artificial cloud modification for obtaining precipitation. In the period November–March the additional precipitation may be 13–18% of the mean long-term sum of precipitation for this same period. Author

N68-12375*# National Aeronautics and Space Administration, Washington, D. C.

A RECOMMENDED NATIONAL PROGRAM IN WEATHER MODIFICATION. A REPORT TO THE INTERDEPARTMENTAL COMMITTEE FOR ATMOSPHERIC SCIENCES

Homer E. Newell Nov. 1966 100 p refs
(NASA-TM-X-60721; ICAS-10A) CFSTI: HC $3.00/MF $0.65
CSCL 04B

Certain considerations regarding the national program for weather modification are outlined. These include: 1) potential research payoff, 2) potential dollar savings in lessening the destructive effects of weather, and 3) potential gains in enhancing the beneficial effects. The need for both single and multiple agency responsibility for carrying out the program; formal procedures, and coordination, regulation, and control of weather modification activities, are stressed. Recommended plans and areas of research for various governmental departments and agencies for the year 1967 are presented. A wide variety of weather modification activities are described. L.S.

N68-12394# RAND Corp., Santa Monica, Calif.

THEORETICAL COLLISION EFFICIENCIES FOR CLOUD DROPLETS IN THE RADIUS RANGE 10–30 MICRONS

M. H. Davis Nov. 1967 26 p refs
(Contract NSF C-415)
(RM-5419-NSF)

The solution to the problem of determining the forces between two spheres falling in a viscous medium in the regime of Stokes flow is applied to the question of the collision efficiency of falling cloud droplets. The method of Stimson and Jeffery was used to compute the component parallel to the motion of the centers, and the method of Hocking, suitably refined, was used to compute the components perpendicular to the line of centers. These hydrodynamic programs were run repeatedly with different initial separation distances so that the distance for which a collision occurred could be estimated from a series of runs. Linear collision efficiencies computed from these numerical experiments are reported here. The collision efficiencies are continuous curves approaching zero as the ratio of the droplet sizes approaches zero and all approach the same finite value as the ratio of droplet sizes approaches one. These collision efficiencies show no cutoff for small sizes, contrary to Hocking's analysis, and they show a slightly decreased collision efficiency when the ratio of droplet sizes is near 0.6. An appendix presents the equations used in solving the axial and perpendicular components of the motion of the drops. Author

N68-12444# Travelers Research Center, Inc., Hartford, Conn.

BALLISTIC WIND STUDY Quarterly Report, 1 Mar.–31 May 1967

Frederick P. Ostby, Jr. Oct. 1967 41 p ref
(Contract DAAB07-67-C-0296
(ECOM-0296-1; QR-1; Rept.-5; AD-661071)

The overall objective of this study is to continue work begun to investigate the improvement of an integrated ballistic message from multiple stations and the effects of mountainous terrain on space and time variability of meteorological measurements. One of the initial steps carried out during this reporting interval was the preparation of a detailed work plan for the contract year. The plan divides the technical work into five tasks: (1) CRAM modifications and tests; (2) ballistic winds evaluation; (3) withheld data experiments; (4) stability experiments; and (5) prediction techniques. The plan is contained in this report. During the first year of study an objective analysis program, the Conditional Relaxation Analysis Method (CRAM), was developed and applied as a tool for investigation. Under the first task, modifications and improvements to CRAM are presently being carried out. As a part of the second task (ballistic wind evaluation) residual errors (deflection) based on station observations along with those from Ft. Huachuca have been derived and are contained herein. In general, one does not find residual errors increasing as distance increases. The minimum residual error occurred only 2 times in 24 test firings at the station closest to the firing--Ft. Huachuca. On the other hand, the minimum residual error occurred 8 times 50 km to the west southwest, at Nogales. Author (TAB)

N68-12599# Weather Bureau, New York.
SUMMARY OF SCIENTIFIC SERVICES DIVISION DEVELOPMENT WORK IN SUB-SYNOPTIC SCALE ANALYSIS AND PREDICTION—FISCAL YEAR 1966
Fred L. Zuckerberg Jul. 1966 14 p
(W-48; TM-12)

Sub-synoptic observation network coverage during a one-day test operation is reviewed. Problems in weather forecasting and sub-synoptic scale analysis are cited. Preparation of a conditional precipitation climatology aid is described. The aid is based on month of the year, 6 and 12 hour periods of the day, wind direction, and wind speed data. Other sub-synoptic operations mentioned include: procedures for developing objective aids for forecasting precipitation probability, use of meteorological data obtained from a Philadelphia television tower, use of a radar overlay with sub-synoptic maps, and the status of interpretation of satellite data. E.C.

N68-12600# Weather Bureau, New York.
A SURVEY OF THE ROLE OF NON-ADIABATIC HEATING AND COOLING IN RELATION TO THE DEVELOPMENT OF MID-LATITUDE SYNOPTIC SYSTEMS
Constantine Zois Aug. 1966 39 p refs
(W-47; TM-13)

The influence of surface heat sources and sinks and non-adiabatic overturnings in the development of cyclones and anticyclones is examined. Cyclone models based on the distribution of non-adiabatic heat fluxes in the North Atlantic are discussed. To evaluate the importance of non-adiabatic heating in forecast models, the incorporation of fluxes of latent and sensible heat into a prediction of three hour changes in the thickness of the 1000-500 mb. layer in the vicinity of cyclones is reviewed. It is concluded that non-adiabatic heating is often large in the vicinity of mid-latitude synoptic disturbances, contributes to thickness changes of the 100-500 mb. layer in the vicinity of cyclones, and probably leads to changes in the topography of isobaric surfaces. E.C.

N68-12601# Weather Bureau, New York.
THE FORECASTING OF EXTRATROPICAL ONSHORE GALES AT THE VIRGINIA CAPES
Glen V. Sachse (Weather Bur., Norfolk, Va.) Aug. 1966 14 p refs
(W-50; TM-14)

Surface and upper-air conditions were analyzed for extratropical onshore gale occurrences at the Virginia Capes during 1956 through 1960. A total of 26 gales were identified. All resulted from cyclones that originated in a well defined area which included the Gulf of Mexico and the Atlantic Ocean off Florida. A system was developed for early detection on the weather charts of extratropical onshore gales. The system was tested and forecasts were verified about 60% of the time. The remaining 40% mainly involved high small craft activity. The average available warning time was 22 hours. E.C.

N68-12615# Public Health Service, Cincinnati, Ohio. National Center for Air Pollution Control.
CLIMATOLOGY OF STAGNATING ANTICYCLONES EAST OF THE ROCKY MOUNTAINS, 1936–1965
Julius Korshover (Environ. Sci. Serv. Admin.) 1967 21 p refs
(PB-174709; PHS-Publ.-999-AP-14) CFSTI: HC $3.00/MF $0.65

Since stagnating anticyclones are often associated with incidents of heavy air pollution in urban areas, a 30 year climatology is presented to delineate occurrences of stagnating anticyclones in the eastern United States. Occurrences of stagnation are determined on the basis of pressure gradient values considered with other meteorological factors. Affected areas are depicted on maps by use of a system of grid points. Data showing cases of stagnation and total days of stagnation indicate that stagnation is most likely to occur in autumn months. Author

N68-12662# Weather Bureau, Washington, D. C. Weather Analysis and Prediction Div.
PERFORMANCE OF THE 6-LAYER BAROCLINIC (PRIMITIVE EQUATION) MODEL
Julius Badner Sep. 1966 20 p refs
(WB-TM-FCST-5; PB-173426) CFSTI: HC $3.00/MF $0.65

Comparison of 500 mb progs from the 6-layer primitive equation baroclinic and the 3-level baroclinic models during the test period indicated a slight superiority of the former in the average in terms of SI score. The 6-layer model was definitely superior in two-thirds of the cases during the test period with an improvement of nearly 11 percentage points in skill over persistence. This in itself may not have been sufficient to warrant a substitution for the 3-level model but the potentialities of the new model for better forecasts at other levels, and derivatives of these forecasts, were great. This was confirmed by the very definitely superior performance of the 6-layer model surface prog over the comparable Reed progs made with the 3-level model and the very good showing of the 36 hour numerical progs as compared to the independently produced subjective 30 hour A and FD progs during the test period. The new model is still in a shakedown period; changes in the program are being introduced from time to time. More definitive studies of the performance will be made during the more active fall and winter seasons. For one, subjective examination of the 500 mb progs appeared to indicate that short wave troughs were moved too slowly by the model. The introduction of the 'desmoothing' operator was expected to correct this fault, if it is one, but no evidence is yet available to confirm this. Author

N68-12667# California Univ., Livermore. Lawrence Radiation Lab.
ATMOSPHERIC DIFFUSION OF LARGE CLOUDS
Todd V. Crawford 12 Sep. 1967 29 p refs Presented at the AEC Micrometeorol. Inform. Meeting, Chalk River, Ontario, 12–15 Sep. 1967
(Contract W-7405-ENG-48)
(UCRL-70540; CONF-670931-11) CFSTI: HC $3.00/MF $0.65

Clouds of pollutants diffuse and grow within a coordinate system fixed to the cloud's center. An approach is discussed for predicting the cloud's properties on space scales of a few hundred meters to a few hundred kilometers and for time periods of a few

days. A numerical cloud diffusion model is presented which starts with a cloud placed arbitrarily within the troposphere. Similarity theories at atmospheric turbulence are used to predict the horizontal diffusivity as a function of initial cloud size, turbulent atmospheric dissipation, and time. Vertical diffusivity is input as a function of time and height. Diurnal variations of turbulent diffusion in the boundary layer and effects of temperature inversions, etc. can be modeled. Nondiffusive cloud depletion mechanisms, such as dry deposition, washout, and radioactive decay, are also a part of this numerical model. An effluent cloud, produced by a reactor run, is discussed. Measurements on this cloud, for a period of two days, are compared to calculations with the above numerical cloud diffusion model. Author (NSA)

N68-12670# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
WASHOUT COEFFICIENTS FOR SILVER IODIDE
R. J. Engelmann, D. I. Hagen, W. A. Haller, and R. W. Perkins 21 Sep. 1966 13 p refs Presented at 47th Ann. Meeting of the Am. Meteorol. Soc., New York, 23–26 Jan. 1967
(Contract AT(45-1)-1830)
(BNWL-SA-798; CONF-670106-1) CFSTI: HC $3.00/MF $0.65

Six washout coefficients for silver iodide particles have been measured in light snow, and one in rain. These are on the order of 2×10^{-6} sec^{-1} for a snowfall of 1 mm/hr, and appear to be related to precipitation rate. Although not large, the washout is significant when determining cloud seeding success from the silver content of snow samples. Calculations are given of the area of snowfield contaminated to a chosen level of silver through the process of washout. Naturally occurring silver backgrounds are also presented. Author (NSA)

N68-12706# Hawaii Inst. of Geophysics, Honolulu.
RELATIONSHIP BETWEEN THE TANGENTIAL WIND FIELD AND THE TRANSVERSE CIRCULATIONS OF TROPICAL CYCLONES Final Report
M. A. Estoque Oct. 1966 45 p refs
(Contract CWB-WBG-66)
(HIG-66-22; PB-174801) CFSTI: HC $3.00/MF $0.65

The relationship between tropical cyclone intensity and the extent of the accompanying cirrus shield is investigated theoretically. The approach is based on computing the vertical and the radial motion from specified tangential wind distributions using the equations of motion and then trying to correlate these computed motions with the cirrus cloudiness. The results indicate that strong tangential winds are associated with strong and extensive upward motions, thus tending to qualitatively confirm satellite observations. However, the theoretical models which have been used are not sufficiently realistic to provide a meaningful quantitative relationship between cyclone intensity and characteristics of the cirrus shield. Author

N68-12712# Geophysics Corp. of America, Bedford, Mass.
METEOROLOGICAL VARIABLES CRITICAL TO GEOMETRY OF HURRICANE SPIRAL BANDS Final Report
Wen Tang Aug. 1966 59 p refs
(Contract CWB-11191)
(PB-173433) CFSTI: HC $3.00/MF $0.65

A simple model is developed to investigate the meteorological variables that affect the geometry of hurricane spiral bands. In this model, the geometry of the spiral bands is obtained from the horizontal wave numbers of the vertical velocity oscillation that results from the solution of a three-dimensional, convective model of a hurricane. From the point of view of maximum growth rate, results show that the thermal stability is the dominating meteorological parameter affecting both the angle between the cloud band and the tangential wind direction (cross-angle) and the spacing of the spiral bands. The more unstable the atmosphere, the smaller the cross-angle and the smaller the spacing between cloud bands. For slightly unstable cases, the vertical shear of tangential wind is also important. In these cases, the larger the vertical shear of tangential wind, the larger the cross-angle and the larger the spacing. The radial wind component, in this simplified model is shown to have only a minor effect on the geometry of the spiral bands. An improved model is developed and various mathematical methods for solving the governing equations are investigated. Suggestions for future continuing investigations are outlined. Author

N68-12714# Weather Bureau, New York.
SOLAR RADIATION AND CLOVER TEMPERATURE
Alex J. Kish (Weather Bur., Clemson, S. C.) Sep. 1966 7 p refs
(W-49; TM-15)

An agricultural meteorology experiment is discussed in which temperature measurements were recorded of air at a height of five feet and of clover creeping stems (stolens) at the surface of the soil. Recordings were taken on a clear summer day and on a partly cloudy summer day. The air temperature was recorded on a hygrothermograph in a standard shelter. A pyreheliograph recorded solar radiation. Thermistor thermometers were used to measure the temperature of the stolons. Comparison of the stolon and air temperature measurements indicates that standard airport meteorological data fails to give an accurate account of low growing crop temperatures. E.C.

N68-12716# Massachusetts Inst. of Tech., Cambridge. Dept. of Meteorology.
ROUND HILL TURBULENCE MEASUREMENTS. VOLUME 4: DATA TABULATIONS FOR RUNS 66E THROUGH 76B
H. E. Cramer, F. A. Record, and J. E. Tillman 14 Dec. 1966 275 p
(Contract DA-AMC-28-043-65-G10)
(ECOM-65-G10, V. 4; AD-661036)

The volume contains the data summaries for Runs 66E through 76B. Vertical profiles of mean wind speed, air temperature, and soil temperature are presented in Section I. Section I also includes estimates of terms of the heat-budget equation. Turbulence statistics are presented in Section II. For a description of the field experiments and the data-processing procedures, reference should be made to Volume I (AD-661 033) of this series. Author (TAB)

N68-12721 Joint Publications Research Service, Washington, D. C.
PRINCIPLES AND METHODS FOR MODIFYING CONVECTIVE CLOUDS USED BY THE CAUCASUS EXPEDITION IN 1964–1965
G. K. Sulakvelidze 4 Dec. 1967 30 p refs Transl. into ENGLISH from Tr. Vysokogornogo Geofiz. Inst. (Leningrad), no. 5, 1966 p 150–168
(JPRS-43546) CFSTI: $3.00

The mechanism of hail formation is discussed and principles for modifying hail-bearing clouds are proposed. The article also described a method for injecting the reagent into a cloud and the results of experimental and practical work for modification of hail processes. Author

N68-12762# Allied Research Associates, Inc., Concord, Mass.
CIRRUS CANOPIES IN TROPICAL STORMS Final Report
Raymond Wexler, Earl S. Merritt, and Dave Chang Aug. 1966 37 p refs
(Contract CWB-11305)
(ARA-8G31-F; PB-173428) CFSTI: HC $3.00/MF $0.65

An analysis is made of the generation, advection, and dissipation processes of the cirrus canopy in tropical storms, with particular emphasis on the formation of sharp edges. It is found that visibility or optical effects are not a factor for an explanation for these edges. Subsidence and accompanying evaporation may be factors, but it is closely tied with the wind flow pattern near the edges. The stronger the radial wind velocity in the vicinity of the edges, the greater is the rate of subsidence required to evaporate the cloud over a distance sufficiently short so that the edge may be considered sharp. Analyses of the wind fields in typical hurricanes indicate that cirrus generated at the eye wall and advected outward could produce a canopy similar to those observed by meteorological satellites in 12 to 18 hours. If, in addition, generation occurs in the spiral arms, these times are shortened somewhat. Sharp edges would occur in regions where the radial outflow becomes small, probably less than 1 m sec^{-1}, and where the tangential velocity is at a relative maximum. Author

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N68-11949*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

PRELIMINARY INFRARED HORIZON PROFILES FROM PROJECT SCANNER

Thomas B. McKee, Ruth I. Whitman, and Richard E. Davis Washington Dec. 1967 25 p refs

(NASA-TM-X-1483) CFSTI: HC $3.00/MF $0.65 CSCL 17G

Measured horizon radiance profiles in spectral bands of 615 cm^{-1} to 715 cm^{-1} (CO_2) and 315 cm^{-1} to 475 cm^{-1} (H_2O) from Project Scanner flight of August 16, 1966, are shown. Excellent agreement between measured and analytically predicted radiance profiles in the CO_2 region verifies the analytical technique to within the experimental accuracy. The agreement of measured with predicted profiles and the lack of dependence on presence of clouds indicate the 615 cm^{-1} to 715 cm^{-1} region is a good candidate for use in attitude determination applications. Horizon profiles in the 315 cm^{-1} to 475 cm^{-1} region show a strong dependence on the presence of clouds which indicates that the spectral region would be a poor one for attitude determination applications. Author

N68-12177 Federal Aviation Agency, Washington, D. C. Systems Research and Development Service.

ALTERNATIVE APPROACHES FOR REDUCING DELAYS IN TERMINAL AREAS

Milton Meisner, Edward Van Duyne, and Walter Faison Nov. 1967 238 p

(RD-67-70) CFSTI: $3.00

This study presents alternative approaches, regulatory and technical, to reducing aircraft delays in terminal areas. Delays and benefits versus cost were examined for runway, taxiway, and ILS improvements; new airports; air traffic control procedural changes; automation of the final approach control function; and reduction of schedule peaks. The specific airports studied were: Kennedy International, La Guardia, Newark, Washington National, Chicago O'Hare, Los Angeles, San Francisco and Oakland. Author

N68-12238 Bunker-Ramo Corp., Canoga Park, Calif.

ALL WEATHER LANDING SIMULATION FOR CATEGORY III AIRBORNE CONFIGURATION. VOLUME 1: SUMMARY OF STUDIES ON FLIGHT DIRECTORS AND SPLIT AXIS CONTROL Final Report

C. A. Gainer, R. D. Monroe, J. E. Brown, C. M. Bertone, D. W. Nichols et al Jul. 1967 115 p

(Contract FA64WA-5143)

(SRDS-RD-67-56, 1) CFSTI: $3.00

Two flight simulation studies were completed testing the feasibility of current display-control concepts and hardware for commercial subsonic jet transport all-weather (Category III) approach and landing. A total of 3,780 simulated landings were flown by 76 B707-720B qualified pilots. The percentage of successful touchdowns (Study 1=42%; Study 2=65%) was not acceptable for Category III operation. It was concluded that current flight director displays require modification for improved flare and decrab information. While pilots expressed a clear preference for integrated roll bar over crosspointer displays, performance data were essentially equivalent. Lateral control problems were the greatest single cause of unsuccessful touchdowns; an improved decrab presentation only slightly improved performance. The introduction of display and control failures during approach has a detrimental effect on performance at touchdown. While actively engaged on manual vehicle control, pilots overlooked many display failures, and, on some approaches where two successive display failures were given, a large number of pilots did not detect the second failure. The need for improved fault warning displays was clearly demonstrated. Current control-display concepts for this mission segment create a serious workload problem for the pilot; it was demonstrated that the use of autothrottle and split axis control reduces workload and improves approach and landing performance. Author

N68-12250*# TRW Systems Group, Redondo Beach, Calif.

RADIO/OPTICAL/STRAPDOWN INERTIAL GUIDANCE STUDY FOR ADVANCED KICK STAGE APPLICATIONS. VOLUME 2: (DETAILED STUDY RESULTS) Final Report

30 Jun. 1967 450 p refs

(Contract NAS12-141)

(NASA-CR-86012; TRW-07398-6017-R000) CFSTI: HC $3.00/MF $0.65 CSCL 17G

Discussions are presented on mission characteristics, the guidance systems, and performance analyses for each phase of the missions. The major emphasis was placed on defining the configuration of the onboard optically aided strapdown inertial subsystem, and the definition and analysis of the functional and performance requirements for the equipment. The assumptions and ground rules are given for the synchronous earth satellite, Mars orbiter, and lunar orbiter missions, and the solar probe with Jupiter assist. The radio/optical/strapdown inertial guidance system, and the guidance subsystems are described, along with the electro-optical sensors. Details are also presented on the performance analysis for the powered flight regime, and the navigation performance analysis for interplanetary trajectory phases, including midcourse and planetary orbit insertion maneuvers. The Mars approach guidance using DSIF tracking plus an onboard optical/inertial system is also discussed. N.E.N.

N68-12345*# TRW Systems Group, Redondo Beach, Calif.

RADIO/OPTICAL/STRAPDOWN INERTIAL GUIDANCE STUDY FOR ADVANCED KICK STAGE APPLICATIONS. VOLUME 1: SUMMARY Final Report

T. W. Layton 30 Jun. 1967 136 p refs

(Contract NAS12-141)

(NASA-CR-86011; TRW-07398-6016-R000, V. 1) CFSTI: HC $3.00/MF $0.65 CSCL 17G

The onboard, optically-aided strapdown inertial subsystem configuration is defined, and the functional and performance

requirements for this equipment are analyzed. Launch vehicle/payload combinations were postulated for four missions, and the kick stage or final propulsive stage is identified for each. Summary data are presented on the characteristics of the synchronous earth satellite, Mars orbit, lunar orbit, and solar probe with Jupiter assist missions; guidance system operational sequences, performance requirements, and equipment configurations; performance analyses of candidate optical/inertial system for boost flight and synchronous orbit insertion, and for the midcourse phase; and the navigation performance analyses for interplanetary and planet approach phases. It was generally concluded that guidance functions for the four missions can feasibly be accomplished by using appropriate combinations of navigation sensors consisting of ground-based radio tracking and onboard inertial and optical sensors. M.G.J.

N68-12383*# TRW Systems Group, Redondo Beach, Calif.
RADIO/OPTICAL/STRAPDOWN INERTIAL GUIDANCE STUDY FOR ADVANCED KICK STAGE APPLICATIONS. VOLUME 3: STATE-OF-THE-ART SURVEYS Final Report
30 Jun. 1967 118 p refs
(Contract NAS12-141)
(NASA-CR-86013; TR-07398-6018-R000, V. 3) CFSTI: HC $3.00/MF$0.65 CSCL 17G

State of the art surveys are presented for electro-optical sensors and strapdown inertial guidance instruments and sensor assemblies, and an assessment is made of their potential use in four future unmanned space missions: a synchronous earth orbiter, a Mars orbiter, a lunar orbiter, and a solar probe with a Jupiter assist. A brief description, including manufacturer, contracting agency and function, is given for sun sensors, earth horizon sensors, star trackers, star field sensors, and planetary sensors. Physical characteristics and performance data are presented for selected single degree of freedom, two degree of freedom, free rotor, and electrostatically suspended gyros, as well as pendulous force and integrating accelerometers and strapdown sensor assemblies. E.J.S.

N68-12391 Federal Aviation Agency, Oklahoma City, Okla. Dept. of Transportation.
AN INVESTIGATION AND DEVELOPMENT OF AN RBDE-4 QUICK RECOVERY MODIFICATION Final Report
James M. Shirley Oct. 1967 23 p refs
(RD-67-63)

The objective of this investigation was to determine if it is feasible to significantly improve the recovery time of the RBDE-4 system after it has gone through an interruption of primary power. Tests made on two RBDE-4 systems showed they were left inoperable for approximately 2.5 minutes, even though the interruption of primary power lasted only a few seconds. Further tests and investigations provided a quick recovery modification to the RBDE-4 scan converter. This modification returns the RBDE-4 system to normal approximately 120 seconds earlier than without the modification. Since primary power failures often occur at a time when air traffic controllers most need the radar information, a return to normal 120 seconds earlier is considered a significant improvement in recovery time. Author

N68-12534# Martin Co., Baltimore, Md.
INTEGRAL OF MC WITH RESPECT TO TIME INTEGRATED MAINTAINABILITY CRITERIA DEVELOPMENT TECHNIQUE Technical Report, 1–10 Apr. 1967
A. E. Holmes, W. S. McQuay, and J. F. Costick, III Wright-Patterson AFB, Ohio. AF Aero Prop. Lab. Sep. 1967 196 p refs
(Contract AF 33(615)-3567)
(AFAPL-TR-67-93; AD-661297)

The report covers a study on design criteria for in-space maintenance. A general procedure is set up to develop the maintainability design criteria. It is recognized that just as development of a guidance system for a new spacecraft requires writing of design criteria oriented to the specific mission and system requirements, so does development of a support system require design criteria oriented toward the specific requirements. A bookkeeping matrix system is set up to provide an orderly method of assessing requirements, eliminating commonalities, and presenting information in a manner conducive to logical tradeoffs. The systematic sequence of logical questions is discussed and general solutions are evaluated. This report evaluates the problems of data which is not readily available today, and what steps will have to be taken to eventually solve the data problem. This technique will provide for integration of support decisions and system design decisions to improve system effectiveness. TAB

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N68-11980*# Aerojet-General Corp., Sacramento, Calif. Nuclear Rocket Operations
[NERVA PROGRAM] Summary Report No. 6, Period Ending 30 Sep. 1967
Nov. 1967 599 p refs
(Contract SNP-1)
(NASA-CR-91051; RN-A-0010) CFSTI: HC $3.00/MF $0.65 CSCL 21F

Major efforts on the NERVA engine development program are identified as (1) mating the experimental engine cold flow with the engine test stand; (2) upgrading the fuel endurance capability to ensure achievement of the 60-min full power full duration objective for NRX-A6; (3) radiation effects tests including explosive materials, structural materials, and pressure transducer; and (4) design and parametric analyses. The technical discussion covers propellant feed system, reactor system integration, thrust chamber assembly, engine controls, systems analysis, mechanical and electrical ground support equipment, instrumentation, ground operations safety, product assurance, flight malfunction, nonfuels materials, and special test equipment. Program management and the support and operations of the Nuclear Rocket Development Station are also discussed. M.G.J.

N68-11982# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
GUNYA: A SYSTEM OF CODES FOR THE PREPARATION GYMEA CROSS SECTION DATA LIBRARIES
J. L. Cook Sep. 1966 16 p refs
(AAEC/E-163)

A system of computer programs called GUNYA is described which prepares multigroup cross section information suitable for input to the burnup code GYMEA. Author (NSA)

N68-11984# Atomic Energy Commision Research Establishment, Lucas Heights (Australia).
THERMAL AND STRESS PERFORMANCE OF A PEBBLE BED REACTOR

P. A. E. Hawker Sep. 1966 19 p refs
(AAEC/TM-344)

A method for determining the thermal and stress performance of a pebble bed reactor is described. Some results based on this analysis are presented to indicate the likely trends. Author (NSA)

N68-11988# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).

PERTURBATION THEORY APPROACH TO FUEL MANAGEMENT STUDY OF THE PEBBLE BED REACTOR

A. Bicevskis Sep. 1966 16 p refs
(AAEC/E-161)

A method based on perturbation theory is given to assess the relative merits of fuel management schemes for the pebble bed reactor. The method is suitable for multigroup treatment and can be applied to other continuously fuelled reactors. As a specific example the computer code N.I.B. is developed based on spectrum weighted one-group treatment. Preliminary reactivity lifetime investigations are described. Some power density calculations are also reported for a random distribution of the pebbles. Author (NSA)

N68-11998*# Oak Ridge National Lab., Tenn.

PROGRAM FOR CALCULATING OPTIMUM DIMENSIONS OF ALPHA RADIOISOTOPE CAPSULES EXPOSED TO VARYING STRESS AND TEMPERATURE

J. P. Nichols and D. R. Winkler Apr. 1967 82 p refs
(Contract W-7405-ENG-26)
(NASA-CR-72172; ORNL-TM-1735) CFSTI: HC $3.00/MF $0.65
CSCL 18B

A method and computer program were developed for calculating the creep and optimizing the dimensions of capsules filled with alpha-emitting radioisotopes. The method solves an integral equation that was developed assuming linear accumulation of partial creep lives and relating life to time-dependent stress and temperature using the Larson–Miller parameter. The computer program, CAPSUL, is written in Fortran language for the IBM 360/75 computer. The program makes a least squares fit of the creep life function using conventional constant stress and constant temperature creep data. Dimensions of capsules having maximum thermal power per unit of weight, volume, or area are calculated for a given creep life and pressure–temperature history using a numerical Lagrange Multiplier formulation. The program also calculates the life to a prescribed strain for capsules of given dimensions and pressure–temperature history. The method has been used to analyze creep data for the alloys 304 stainless steel, Hastelloy N, Cb-1% Zr, FS-85, and T-222. Author (NSA)

N68-11999# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).

EXPERIMENTAL ASSESSMENT OF A PEBBLE REFLECTOR AND PEBBLE FLOW IN A SMALL SCALE RECIRCULATING PEBBLE BED

L. R. Scott Rogers Aug. 1966 28 p
(AAEC/TM-339)

The erosion behavior of a pebble reflector was examined using small scale, three-dimensional, pebble-bed models and the split-bed technique. An exponential-type change in the reflector-fuel interface angle was indicated. Data on downflow and upflow air tests with small-scale, recirculating pebble beds are also presented. These data indicated a variation in pebble discharge ratio of some 20% relative to the no-airflow case. Author (NSA)

N68-12000# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Angewandte Reaktorphysik.

TERM-1 SYSTEM

W. Gmelin Aug. 1966 76 p refs Performed under United States–Euratom Fast Reactor Exchange Program
(KFK-462; EURFNR-215F)

A description of the TERM-1 system is presented. TERM-1 is a management system for scheduling control in supervision of projects. The most important deadlines are determined from the network plan input; from this the most important activities are determined. The application of this program to fast breeder reactor research is discussed. NSA

N68-12004# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).

A BURNUP SURVEY OF PU-TH-BEO FUELS AND COMMENTS ON SELECTION OF FUEL FOR PEBBLE BED REACTORS

A. Bicevskis Nov. 1966 21 p refs
(AAEC/TM-350)

The results of a burnup survey for a BeO pebble bed reactor system are reported. The survey was based on an equilibrium model and carried out by means of the GYMEA complex of codes. A once-through fuel cycle was assumed with Pu and Th as the fissile and fertile materials. The selection of a fuel composition is discussed, taking into consideration reactivity lifetime, initial power density, and temperature coefficients of reactivity. With a 200 MWe pebble bed reactor design, values of fissions per initial fissile atom of 1.2 to 1.4 appear to be achievable at an average bulk power density of 11 W/cm^3. Author (NSA)

N68-12051# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).

A METHOD FOR MEASURING THE FLUID FLOW DISTRIBUTION AT EXIT FROM A RIGHT CYLINDRICAL, RANDOMLY PACKED BED

J. Price and J. R. Stevens Oct. 1966 21 p refs
(AAEC/TM-354)

A method for measuring the fluid flow distribution at exit from a right cylindrical, randomly packed bed of spheres has been investigated using a flow separator to prevent redistribution of the flow between the exit face of the bed and the plane of measurement. Three designs of separator were tested, for each of which steady fluid velocities were measured with a pitot static tube in the exit plane of the separator, and unsteady velocities with a hot wire anemometer. A separator with contracting flow passages was developed which facilitated measurement and reduced turbulence intensities without causing any significant flow redistribution within the bed. Measurements are presented for a loosely packed bed of glass spheres which show that the velocity profile is reasonably uniform over the bed except for a region within a half sphere diameter of the vessel wall. This differs substantially from the profiles measured by most previous investigators. Author (NSA)

N68-12058# Minnesota Mining and Mfg. Co., St. Paul, Minn.

SNAP-23A PROGRAM. PHASE 1: THERMOELECTRIC CONVERTER DEVELOPMENT PROGRAM Quarterly Report, 1 Apr. 1967–30 Jun. 1967

J. V. Wachenheim 30 Jun. 1967 116 p
(Contract AT(30-1)-3824)
(MMM-3824-0009; QR-2) CFSTI: HC $3.00/MF $0.65

Engineering and design data are provided on a 80-watt thermoelectric converter for use as a component in the SNAP 23-A terrestrial radioisotope power supply system. The parameters for the experimental mockup converter are defined. The final design contains 264-couples and achieves a thermal match with the optimized SNAP-23A system. Efforts to improve thermoelectric couples centered on a posttest analysis of SNAP-23 converter and

module, the completion of a bell jar test plan to verify ingradient thermoelectric performance, and 10-couple module tests. Program management plans are outlined. M.G.J.

N68-12100# General Electric Co., Sunnyvale, Calif. Advanced Products Operation.
A PRELIMINARY EMPIRICAL APPROACH TO ESTIMATING REACTOR VESSEL DAMAGE RESULTING FROM A SEVERE NUCLEAR EXCURSION
R. J. Colmar Jan. 1966 33 p refs
(Contract AT(04-3)-189)
(GEAP-5163) CFSTI: HC $3.00/MF $0.65

A preliminary formulation of a method used for evaluating potential vessel damage for liquid-moderated reactors following a severe nuclear excursion is discussed. In contrast, the TNT rationale, intrinsically a gas–liquid phenomenon, is shown to be grossly inappropriate as a reliable simulant of liquid-moderated reactors. Experimental evidence from liquid–vapor transient effects is used to evaluate certain empirical vessel-damage factors numerically. The principal factors evaluated are the fraction of the total energy release that is delivered to the vessel, f_C, and the energy-deposition-depth, H_{eff}. Contemporary data are utilized in a preliminary survey to evaluate these factors. The gross indications afforded by available data are that the mechanical energy that the pressure vessel absorbs is in the order of about 1 to 2% of the energy released to the environment and that the depth over which this energy is deposited is in the order of two vessel diameters provided the water depth over the core (or pressure source) exceeds this value. Author (NSA)

N68-12123# Allis-Chalmers Mfg. Co., Bethesda, Md. Atomic Energy Div.
DESIGN, DEVELOPMENT, AND FABRICATION OF PROTOTYPE LOW-ENRICHED SUPERHEATER FUEL ELEMENTS (LESH)
D. A. Lampe, comp. and T. M. Raby, comp. Apr. 1967 132 p refs
(Contract AT(11-1)-589)
(ACNP-67516) CFSTI: HC $3.00/MF $0.65

The development of low-enrichment superheater fuel elements is presented. Mechanical design and analysis is detailed. A thermal and hydraulic analysis is performed. The physics analysis and safeguards analysis are discussed. NSA

N68-12175# Naval Research Lab., Washington, D. C.
IRRADIATION EFFECTS ON REACTOR STRUCTURAL MATERIALS Quarterly Progress Report, 1 May–31 Jul. 1967
J. Russell Hawthorne, Charles Z. Serpan, Jr., Henry E. Watson, Frank J. Loss, Uldis Potapovs et al 15 Aug. 1967 46 p refs
(NRL-1808; AD-661229)

The report includes the following: (1) through-thickness radiation resistance of two A533 Grade B, Class I steel plates at 550 F, (2) directional notch ductility performance of irradiated 3-1/2Ni-Cr-Mo and 5Ni-Cr-Mo-V steel plates, (3) radiation sensitivity of A353 (9% nickel) steel as influenced by percent retained austenite, (4) tensile properties behavior versus postirradiation test temperature of selected structural steels, (5) potential for aging embrittlement of pressure vessel steels, (6) postpressurization test operations on PM-2A reactor pressure vessel, and (7) auxiliary equipment developed for elevated temperature remote tension testing of radioactive specimens. Author (TAB)

N68-12184 Advisory Group for Aerospace Research and Development, Paris (France).
NUCLEAR, THERMAL AND ELECTRIC ROCKET PROPULSION. FUNDAMENTALS, SYSTEMS, AND APPLICATIONS
New York Gordon and Breach Sci. Publishers 1967 651 p refs Lectures presented in Brussels, 12–21 Nov. 1962 and 28 Sep.–2 Oct. 1964; Sponsored by AGARD and Brussels Univ.
(AGARDograph-101)

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7. NUCLEAR SPACE POWER SYSTEMS: REACTORS, CONVERSION EQUIPMENT, AND POWER SYSTEMS TECHNOLOGY H. M. Dieckamp (Atomics Intern.) p 361–504 refs (See N68-12191 03-22)

8. ADVANCED TECHNOLOGY FOR LARGE SPACE POWER SYSTEMS M. A. Zipkin (GE) p 505–539 (See N68-12192 03-22)

9. ELECTRIC PROPULSION: SYSTEMS, FLIGHT MECHANICS, POWER SOURCE, AND MISSION APPLICATIONS E. Stuhlinger (NASA. Marshall Space Flight Center) p 540–625 refs (See N68-12193 03-28)

N68-12185 Space Technology Labs., Inc., Redondo Beach, Calif.
THE ROLE OF NUCLEAR ENERGY IN SPACE FLIGHT
R. W. Bussard *In* AGARD Nucl., Thermal and Elec. Rocket Propulsion 1967 p 1–18 (See N68-12184 03-22)

Long-term requirements for practical manned space flight are reviewed, and it is shown that the rocket vehicle systems needed must be capable of providing incremental velocity changes of 100,000 ft/sec to 250,000 ft/sec. It is pointed out that these values are from two to five times greater than the capabilities of chemical rocket propulsion systems. A survey of the technical possibilities indicates that nuclear/thermal rockets of both high and low thrust can improve capabilities in the next two decades, that nuclear/electric systems offer promise for the last two decades of this century, and that fusion propulsion may provide the eventual system for manned flight early in the 21st century and later allow the first attempts at interstellar probes and travel. Author

N68-12186 Space Technology Labs., Inc., Redondo Beach, Calif.
FUNDAMENTALS OF NUCLEAR PROPULSION
R. W. Bussard *In* AGARD Nucl., Thermal and Elec. Rocket Propulsion 1967 p 21–83 refs (See N68-12184 03-22)

The basic principles of nuclear propulsion are reviewed, with emphasis placed on the nuclear reactor aspects of nuclear thermal propulsion systems, and to the flight dynamics of nuclear electric propulsion systems. Vehicle performance is analyzed in terms of external ballistics and internal dynamics. In discussing reactor neutronics, the principles of fission reactors are defined in relation to nuclear reactions and reactor criticality, and neutron

diffusion and slowing-down. Criticality and time-dependence in reactors are examined with attention centered on the Fermi-age theory, heterogeneous systems, and transient changes in criticality. Radiation sources and hazards are assessed. The physical mechanisms of radiation attenuation are given as a basis for the mathematical analysis, and shielding design problems are considered. Equations for determining heat transfer and fluid flow are formulated. Materials properties and selection criteria are provided for propellants, fuel elements, moderators, and reflectors. The technical areas of reactor design are described, and engine system components and system integration are discussed. M.G.J.

N68-12187 Space Technology Labs., Inc., Redondo Beach, Calif. Propulsion Research Dept.

ISOTOPE THERMAL THRUSTERS AND APPLICATION

John S. Martinez *In* AGARD Nucl., Thermal and Elec. Rocket Propulsion 1967 p 87–154 refs (See N68-12184 03-22)

The advantages of radioisotope propulsion systems are cited, and typical radioisotope/thermal thruster systems are described. Relationships of radioisotope propulsion to nuclear reactor, electric, and chemical propulsion are indicated. An overview of isotope heat source technology is presented, with data given on the properties of typical isotope compounds, isotope availability, and estimated costs. Specific α-, β-, and γ-heated thruster designs and the expected experimental performances of each are described. Details are given on the Poodle α- and β-heated systems. The influence of isotope thrusters on stage design is examined, with attention focused on an α-Poodle-powered stage designed for launch by the Titan II or the Titan II/Centaur boost vehicle. The effect of low acceleration environment on stage subsystem design and operation is considered. Low thrust orbital mechanics relationships governing both orbit transfers and solar probes are discussed and compared with conventional high thrust relationships. These data are used to compare the relative payload capabilities of isotope systems with other forms of propulsion for these missions. M.G.J.

N68-12188 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

FAST AND MODERATED REACTORS AND APPLICATIONS OF LOW-POWER NUCLEAR ROCKETS

Frank E. Rom *In* AGARD Nucl., Thermal and Elec. Rocket Propulsion 1967 p 155–241 refs (See N68-12184 03-22)

The fundamental reactor types are described, and the possibility of providing low power lightweight reactors for nuclear rocket application is examined. The nuclear propulsion scheme considered is the direct heating system where hydrogen is heated by passing it through a reactor core. The properties of high temperature materials available for nuclear rocket–reactor application are defined in terms of melting point, tensile strength, creep strength, thermal conductivity, expansion coefficient, modulus of elasticity, reaction with hydrogen propellant, evaporation rates, compatibility with fuel compounds, and nuclear cross section. Reactor concepts and configurations are discussed, along with the necessary compromises for achieving feasible propulsion systems, and performance estimates. The potential applications of small fast and thermal nuclear rockets are listed as solar, planetary, and deep space probes, and manned and unmanned interplanetary missions. Power and operating time requirements are computed. M.G.J.

N68-12189 Space Nuclear Propulsion Office SNPO, Atomic Energy Commission, Germantown, Md.

NUCLEAR ROCKETS BASED ON GRAPHITE REACTOR TECHNOLOGY, THEIR APPLICATIONS AND DEVELOPMENT STATUS

Harold B. Finger, Paul G. Johnson, John E. Morrissey, and Alan R. Siegel *In* AGARD Nucl., Thermal and Elec. Rocket Propulsion 1967 p 242–337 refs (See N68-12184 03-22)

An overview is presented on the design and operating characteristics of nuclear rocket engines required for difficult space missions involving extended stay-times on the moon, lunar bases, large instrumented missions throughout the solar system, and manned exploration of the near planets. Details are given on the NERVA configuration; the major technical considerations that determine the configuration, and that determine and limit the operating characteristics and performance of the overall engine system; and the steady state and transient engine operation. The status of reactor and nonnuclear component and overall system development and operation is discussed. Consideration is also given to configurations of higher powered engines and the development of higher power reactor systems. The potential use of clustered engine configurations in actual space mission applications of nuclear rockets is also discussed. Author

N68-12190 Space Nuclear Propulsion Office SNPO, Atomic Energy Commission, Germantown, Md.

OPERATIONAL SAFETY OF NUCLEAR ROCKETS

George P. Dix *In* AGARD Nucl., Thermal and Elec. Rocket Propulsion 1967 p 338–357 refs (See N68-12184 03-22)

A basic safety philosophy is outlined, and a simplified analytical model is presented on the nuclear rocket engine, vehicle, missions, and the launch environment. Various potential safety problems and respective countermeasure techniques are discussed within the framework of the conceptual operational chronology. This included developmental ground testing operations as well as flight operations. A three-part safety program is described: (1) countermeasure development directed at the problems posed by credible transport and ground handling accidents, launch pad aborts, shallow water impact, and the post-mission disposition of the nuclear rocket; (2) safety analyses to define the radiation source term, and the temporal and spatial history of both normal and abnormal nuclear rocket operations; and (3) environmental safety analysis to assess the effect of the accidental introduction of the radiation source into the biosphere, and its effects upon man. M.G.J.

N68-12191 Atomics International, Canoga Park, Calif. Space Systems Dept.

NUCLEAR SPACE POWER SYSTEMS: REACTORS, CONVERSION EQUIPMENT, AND POWER SYSTEMS TECHNOLOGY

H. M. Dieckamp *In* AGARD Nucl., Thermal and Elec. Rocket Propulsion 1967 p 361–504 refs (See N68-12184 03-22)

The state of the art of nuclear power systems is reviewed, and the specific objectives of the SNAP program are delineated. Reactor heat sources are described in terms of nuclear fission, the chain reaction, and reactor design, and heat rejection equations are derived. Specific reactor requirements for a space power application are established, and a reactor-power conversion combination is selected. This is done by assessing the three major subsystems for nuclear space power plants: the reactor heat source, the power conversion cycle, and the waste heat radiator. The Rankine and Brayton cycles, thermoelectric, and thermionic power conversion systems are described, and the performance capabilities and limitations of each concept are discussed. The criteria for vehicle integration are defined. Design details and operational test data are given on the SNAP hydride reactor, SNAP 10A, and SNAP 2. M.G.J.

N68-12192 General Electric Co., Cincinnati, Ohio. Space Power and Propulsion Section.

ADVANCED TECHNOLOGY FOR LARGE SPACE POWER SYSTEMS

Morris A. Zipkin *In* AGARD Nucl., Thermal and Elec. Rocket Propulsion 1967 p 505–539 (See N68-12184 03-22)

Developments relating to energy conversion components in the field of large turbo-nuclear, Rankine cycle, alkali metal

working fluid space power system technology are discussed. Particular emphasis is placed on suitable containment materials for operation at high temperature in the space environment, boiling and condensing processes in the cycle and in such components as the turbine and pumps, and reliable and stable liquid metal lubricated bearings. Among the results reported are: (1) evidence of satisfactory corrosion resistance of columbium alloys containment materials for operation with liquid alkali metals at temperatures as high as 2200°F for periods up to 10,000 hours; (2) alkali metal boiling data at temperatures to 1850°F, indicating the potential for maintaining nucleate boiling and high heat transfer coefficients in space power system boilers; and (3) definitive results of an electromagnetic pump technology study indicating that design innovation can reduce weight while retaining inherent reliability and control advantages. M.G.J.

N68-12202# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
ANALYSIS OF SNAPTRAN REACTOR BEHAVIOR
W. E. Kessler, R. E. Prael, and L. N. Weydert, Jr. Jun. 1967 19 p refs
(Contract AT(10-1)-205)
(IDO-17204) CFSTI: HC$3.00/MF$0.65

The SNAPTRAN program provides nuclear safety information of the rapid transient behavior of ZrH–U fuels. Knowledge of the fission energy source as a function 6f time in conjunction with knowledge of the fuel temperature yielded a well defined trend from which an evaluation of the specific heat of the fuel was obtained. The specific heat was found to be described by a linear temperature-dependent term plus an Einstein oscillator model temperature-dependent term. The SNAPTRAN reactor temperature coefficient, calculated using this specific heat formulation, varied from −0.10 to −0.18 cents/°F in the range of 100 to 1200°F. Author (NSA)

N68-12206# Atomics International, Canoga Park, Calif.
MEASUREMENT OF THE EFFECTIVE RESONANCE INTEGRAL, THERMAL ATTENUATION FACTOR, AND DOPPLER EFFECT IN GOLD OVER A WIDE RANGE IN SURFACE MASS RATIO AND TEMPERATURE
L. S. Beller and H. Farrar, IV 15 Aug. 1967 62 p refs
(Contract AT(04-3)-701)
(NAA-SR-12499) CFSTI: HC$3.00/MF$0.65

Measurements of the effective resonance integral, thermal and epithermal self-shielding factors, and Doppler coefficients α and β in the isotope ^{197}Au are reported. The measurements cover a range of more than four decades in surface/mass ratio (S/M), and 500°C in temperature in four steps. The measurements were made by activation in a nominally 1/E neutron energy spectrum. The objective was to provide correlated experimental data—the accuracies and limitations of which are well understood—for use in examining the effect of theoretical approximations in the calculation by analytical methods of both resonance integrals and Doppler effects. The measurements disclosed comparatively large discrepancies with the TRIX-I theory, due to certain approximations that originally had been considered to have only minor effect. As a result, calculational methods have been improved, and the new methods (TRIX-II code) are in excellent agreement with the measurements. The present measurements are believed to constitute the first in which the Doppler effect as a function of temperature extends over a large span in S/M, and into the thin-sample region dominated by a single resonance. Author (NSA)

N68-12212# Atomics International, Canoga Park, Calif.
NONNUCLEAR PERFORMANCE OF SRE–PEP SYSTEMS
A. L. Gunby 30 Jun. 1967 59 p refs
(Contract AT(04-3)-701)
(NAA-SR-12408) CFSTI: HC$3.00/MF$0.65

The modifications for the SRE facility for higher temperature and power and greater reliability are given. Performance testing of the modifications is discussed. Gas entrainment for the SRE–PEP Na primary pumps is discussed. The capability of retrieving metallurgical sample tabs from radioactive primary sodium without interrupting reactor operation was checked out. Instrumentation check-out revealed unstable amplifiers in the heat transfer portion and inadequate diodes in the reactor safety system. Corrections to these instrumentation deficiencies are outlined. NSA

N68-12217 India. Dept. of Atomic Energy, Bombay.
PREPARATION OF A PLUTONIUM–BERYLLIUM ALLOY NEUTRON SOURCE
P. R. Roy, R. G. Deshpande, and T. S. Laxminarayanan 1967 15 p refs
(BARC-294) CFSTI: $3.00

Details are given on the preparation of a plutonium–beryllium source containing one curie of plutonium and with an output requirement exceeding a million neutrons per second. An alloy composition with a Be:Pu ratio of 30 was chosen, corresponding to a maximum yield of 46 $n/10^6$ alphas. Vacuum degassing of the powders was avoided, and a dynamic argon atmosphere was maintained in the chamber. It was found that the sintered pellets shrunk in size instead of dimensionally increasing due to the reduction reaction during heating; no appreciable distortion of the overall shape of the sintered compacts was noted. Determination of the neutron yields showed that the efficiency of the source was better than 90%. M.G.J.

N68-12244# Los Alamos Scientific Lab., N. Mex.
THE LOS ALAMOS COUPLED REACTOR EXPERIENCE
C. G. Chezem, G. H. Hansen, H. H. Helmick, and R. L. Seale (Ariz. Univ., Tucson) 16 Jan. 1967 52 p refs
(Contract W-7405-ENG-36)
(LA-3494) CFSTI: HC$3.00/MF$0.65

The interaction among the cores in a cluster of nuclear rocket reactors and the resulting static and kinetic behavior of the array has been studied analytically. Lumped-parameter models of two-core coupling have been analyzed by neutron pulsing and rod oscillation and their salient features verified at zero power by a variety of measurements on two Kiwi-type reactors operating in proximity. The Kiwi "free-space" coupling coefficients were determined experimentally to be 24.7, 11.9, and 3.3 cents at 6, 9, and 16 ft center-to-center separations. Perturbation of the fission distribution as a result of interaction at equal power was less than 5% at 6 ft. No neutronic instability was found either in the theoretical models or in the experimental behavior. Temperature dependence is introduced into the coupling model based on experimental evidence from the high-power, full-flow operation of a single Kiwi reactor. The temperature-dependent model is then extrapolated to predict the transfer function behavior of both Kiwi and Phoebus clusters under operating conditions. Author (NSA)

N68-12259# Bettis Atomic Power Lab., Pittsburgh, Pa.
PRESSURIZED WATER REACTOR (PWR) PROJECT Technical Progress Report, Jan. 21–Apr. 21, 1967
21 Apr. 1967 90 p
(Contract AT(11-1)-GEN-14)
(WAPD-MRP-120) CFSTI: HC$3.00/MF$0.65

A summary of the development and operation of the Shippingport pressurized water reactor project is given. Topics discussed are: PWR plant support including fluid systems and plant engineering, control engineering, plant analysis and testing, chemistry applications and plant materials; reactor mechanical design including the refuelling program of the PWR Core 1 and Core 2, PWR-2 Seed 2 reactor design and test, PWR-1 spent component examination program; PWR-2 thermal and hydraulic design; PWR nuclear analysis for operations; materials irradiation for fuel

element development; PWR core engineering including enriched ceramic fuel process development, PWR Core 2 Seed 2 fuel elements and poison end supports, and PWR Core 2 Seed 2 fuel assemblies. NSA

N68-12305# Philippine Atomic Energy Commission, Manila.
REACTOR CROSS SECTIONS—A LITERATURE SEARCH
Nov. 1966 131 p refs
(PAEC(A)IN-661)

A bibliography of 805 entries is presented on nuclear reaction cross sections. The references cited were abstracted in Nuclear Science Abstracts during the period September 8, 1948, to October 1965. NSA

N68-12358# General Electric Co., Pleasanton, Calif. Nuclear Technology Dept.
SPECIFIC ZIRCONIUM ALLOY DESIGN PROGRAM Quarterly Progress Report, Oct. 1966–Mar. 1967
H. H. Klepfer, H. J. Busboom, R. E. Blood, D. M. Rooney, and J. S. Armijo Apr. 1967 28 p refs Performed under United States–EURATOM Joint Res. and Develop. Program
(Contract AT(04-3)-189)
(GEAP-5424; EURAEC-1851; QPR-15; QPR-16) CFSTI: HC $3.00/MF $0.65

A Zr + 2.0 at. % Cr + 0.16 at. % Fe alloy is being evaluated as nuclear fuel cladding. Alloy-clad fuel rods will be irradiated in the Consumers Big Rock Reactor to a target exposure of 15,000 MWd/t. The fuel irradiation was delayed by a variable corrosion performance of the first full-scale vendor batch of alloy tubing and bar stock. The difference between the variable performance by material from the large vendor ingot and the reproducibly excellent performance in the same tests by material from small laboratory melts was caused by nonuniform distribution of coarse intermetallic compounds in the vendor material. Laboratory studies resulted in a proposed process for ensuring fine uniform intermetallics under vendor conditions. Vendor fuel tubing was received and is being characterized in intensive mechanical and corrosion tests. Author (NSA)

N68-12420# Oak Ridge National Lab., Tenn.
A SURVEY OF EQUILIBRIUM FUEL-CYCLE COSTS FOR A LOW-ENRICHED, UNCLAD, HELIUM-COOLED UO_2 GRAPHITE REACTOR
C. M. Podewaltz Jun. 1967 55 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1789)

A survey of equilibrium, fuel-cycle costs associated with various combinations of lattice pitch, enrichment and fuel-hole size has been carried out for a gas-cooled, unclad, UO_2-graphite reactor. The UO_2 was assumed to be formed into pellets with no coating applied. Nineteen UO_2 holes intermingled with 42 coolant channels comprised a central cluster region in the graphite cell. Enrichment was varied in the range of natural to 5%; lattice pitch in the range of 10.8 to 14.8 in. Two fuel-hole dia, 0.375 and 0.576 in., were investigated. The reactor was assumed to deliver 1900 MW(t) and 760 MW(e). Multigroup, point-depletion calculations of the homogenized cell were performed utilizing GAM self-shielded, resonance cross sections and flux-weighted THERMOS cross sections. For the set of small fuel-hole reactors a minimum fuel-cycle cost of 1.314 mills/kWhr(e) was found. The reactor for which this cost obtained had a conversion ratio of 0.551, and a burnup of 41,083 MWd/t. For the large fuel-hole set the corresponding values were 1.160, 0.637, and 29,400. Author (NSA)

N68-12422# Argonne National Lab., Ill.
REACTOR DEVELOPMENT PROGRAM Progress Report, Dec. 1966
28 Jan. 1967 92 p refs
(Contract W-31-109-ENG-38)
(ANL-7286) CFSTI: HC $3.00/MF $0.65

Items of significant technical progress which have occurred in both the specific reactor projects and the general engineering research and development programs are summarized. Program activities are reported under five broad categories: Plutonium Utilization, Liquid-Metal Fast Breeder Reactors, General Reactor Technology, Advanced Systems Research and Development, and Nuclear Safety. The Experimental Boiling Water Reactor Pu recycle program is discussed under Plutonium Utilization. Liquid-Metal Fast Breeder Reactors include the Experimental Breeder Reactor-II operations, fast zero-power assembly development, and fast reactor physics, components, and fuels development. General Reactor Technology examines applied and reactor physics, fuels and cladding, engineering, chemistry, and chemical separations. The Argonne Advanced Research Reactor development is summarized under Advanced Systems Research and Development. Nuclear Safety activities include coolant dynamics, fuel meltdown, accident analyses, energy transfer, engineering safeguards systems, and TREAT operations. NSA

N68-12423# Babcock and Wilcox Co., Alliance, Ohio. Research Center.
ANALOG SIMULATION OF SODIUM HEATED STEAM GENERATOR Progress Report
J. S. Iyer 31 Jan. 1967 105 p
(Contract AT(11-1)-1280)
(BAW-1280-42; RR-5132) CFSTI: HC $3.00/MF $0.65

Progress in developing a mathematical model to describe the dynamic performance of the 30 MW(t) prototype sodium-heated steam generator is discussed. This project will produce information of importance in applying the sodium-heated steam generator to either a thermal or fast breeder-type reactor plant. A model having a constant heat transfer coefficient at each load has been completely debugged at each of five different load points. The steady state results of the dynamic model were compared with predicted steady state design performance, and found to be in good agreement. The dynamic response of the model was obtained at 100% load using actual installed areas of the prototype. Step perturbations were studied for variations in the flow and temperature of the feedwater, sodium, and spray. The effects of each of these variables on the flow and temperature of the main stream, the boiler outlet, and the sodium outlet were recorded. Recommendations are made for refining the present model and for applying it to the study of the operation of the full scale generator. NSA

N68-12424# Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.
URANIUM PLUTONIUM CARBIDE DEVELOPMENT Quarterly Progress Report, Period Ending 31 Mar. 1967
William E. Ray Apr. 1967 46 p
(Contract AT(30-1)-3791)
(WCAP-3791-4) CFSTI: HC $3.00/MF $0.65

Research and development are reported on fuel material fabrication development, and fuel element fabrication. Results of thermal flux irradiation, fastflux irradiation, and transient flux irradiation studies are included. NSA

N68-12426*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A REACTOR CONCEPT FOR SPACE POWER EMPLOYING THERMIONIC DIODES AND PIPES
Colin A. Heath and Edward Lantz Washington 1967 15 p refs 5th Aerospace Sci. Meeting, New York, 23–25 Jan. 1967
(NASA-TM-X-52370) CFSTI: HC $3.00/MF $0.65 CSCL 18L

A thermionic generator power system using a reactor heat source connected to external diodes by heat pipes is investigated.

A concept is proposed which appears capable of supplying up to several hundred kilowatts of electrical power. Experimental results from laboratory test of both heat pipes and thermionic diodes have been used to set reasonable performance levels for thermionic diodes which are both heated and cooled by heat pipes. A reactor fueled with slab geometry fuel elements of uranium-233 nitride could provide a minimum power of 36 kwe limited by criticality considerations. Reactor control is effected by a combination of moderator and neutron absorbing material in a central region of the reactor. Neutronic calculations indicate that a 6% swing in reactivity is obtainable with this control system. Total mass of the reactor, thermionic diodes, radiator and reactor shield for an instrumented payload is estimated to be 300 kg. Author

N68-12431# Institutt for Atomenergi, Kjeller (Norway).
MEASUREMENTS OF THE SPATIAL VARIATION OF THE THERMAL NEUTRON ENERGY SPECTRUM IN REACTOR CELLS
J. Smit Apr. 1968 15 p refs
(KR-103) CFSTI: HC $3.00/MF $0.65

The spatial variation of the thermal neutron spectrum is measured indirectly in terms of a spectrum index SI, defined as the ratio of the ^{176}Lu: ^{164}Dy activation ratio in experiment to ^{176}Lu: ^{164}Dy activation ratio in thermal spectrum of 20°C. These measurements were carried out in the zero-power reactor NORA in a mixture of heavy and light water (45% H_2O) and in four light water lattices with the lattice pitch and the moderator temperature as parameters. The experimental results are compared with calculations performed using the K-7 THERMOS code with the following three energy transfer models: the free gas model of Brown and St. John, Nelkin's model, and an anisotropic version of Neklin's model due to Koppel and Young. The latter model gives in almost all cases satisfactory agreement with the experimental results. Author (NSA)

N68-12436# Atomics International, Canoga Park, Calif.
TRIX-2 AN ADVANCED ANALYTIC CALCULATION OF RESONANCE INTEGRALS AND DOPPLER COEFFICIENTS. PART 1: THEORY
J. M. Otter 15 Sep. 1967 47 p refs
(Contract AT(04-3)-701)
(NAA-SR-12509, Pt. 1) CFSTI: HC $3.00/MF $0.65

The theory underlying the calculations in the TRIX-2 code is described, and the equations used are given, together with the tabular data utilized. A new technique for removing the flat flux approximation for lumped absorbers in an efficient, convenient manner is also described. The code provides calculations of self-shielding of low-energy cross sections, Dancoff shadowing in lattices, fission widths from channel fission theory, and adjustments to well-known experimental controls, as well as intermediate scattering of all elements. These features give the code the capability of providing, in a single calculation, multigroup resonance integrals and Doppler coefficients for most reactor designs. Author (NSA)

N68-12443 European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.
SABINE—A ONE DIMENSIONAL BULK SHIELDING PROGRAM
C. Ponti, H. Preusch (AIV Buero, Darmstadt), and H. Schubart (Technische Hochschule, Hannover) Brussels Oct. 1967 66 p refs
(Contract EURATOM-149-64-11 ISPD)
(EUR-3636.e) CFSTI: $3.00

This report describes the theory and the use of a program for bulk shield design, written in Fortran IV for IBM 7090 or 360. The removal diffusion model has been applied; particular attention has been paid to the treatment of the removal sources in the diffusion equations. Neutron fluxes for 26 energy groups and gamma fluxes for 7 groups are calculated in plane, cylindrical and spherical geometry. Experimentally determined removal c.s. are used for the more important shielding materials. Gamma sources include the radiation emitted either by fission or neutron capture or inelastic neutron scattering. Three forms of region dependent build-up-factors may be used to determine the gamma fluxes: build-up-factors for 6 materials have been calculated with the BIGGI 3 gamma transport program. Other quantities calculated by SABINE may be any neutron response function, gamma dose and energy deposition. Author

N68-12446# Idaho Nuclear Corp., Idaho Falls.
ETA RATIOS OF PU-239 AND PU-241 RELATIVE TO U-235
E. Fast and E. F. Aber Aug. 1967 42 p refs
(Contract AT(10-1)-1230)
(IN-1060) CFSTI: HC $3.00/MF $0.65

The ratios of the neutron reproduction constants η(Pu-239)/η(U-235) and η(Pu-241)/η(U-235) were determined from reactivity measurements in ARMF-I and ARMF-II. Results for 2200 m/sec and Maxwellian average values are given. Author (NSA)

N68-12454# Bettis Atomic Power Lab., Pittsburgh, Pa.
SIZING OF ZIRCALOY STRUCTURALS
J. H. Suldan and R. J. Krahn Feb. 1967 35 p
(Contract AT(11-1)-GEN-14)
(WAPD-TM-620) CFSTI: HC $3.00/MF $0.65

Experiments in sizing large tubular Zircaloy structurals for nuclear core application by thermal, explosive, and cold hydraulic sizing techniques reveal that thermal sizing is the most suitable process of the three in achieving the required tight diametral and boundary surface tolerances. With cylindrical tubes up to 11-1/2 inches in diameter by 103 inches long and wall thicknesses of 0.062 inch, tolerances which can be met consistently around any desired nominal diameter are ±0.020 and plus 0.025 inch for the diametral tolerance and boundary diameter, respectively. As a result of strain-rate sensitivity of Zircaloy and limitations placed on the amount of elongation permitted which precluded removal of ovality, experiments in explosive sizing were discontinued. Cold hydraulic sizing experiments were discontinued because of the dimensional instability of the sized component under subsequent thermal cycling. Author (NSA)

N68-12464# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
THEORETICAL ANALYSES OF HOMOGENEOUS PLUTONIUM CRITICAL EXPERIMENTS
C. R. Richey 3 Oct. 1966 16 p refs
(Contract AT(45-1)-1830)
(BNWL-SA-780) CFSTI: HC $3.00/MF $0.65

A computational analysis of data from an accumulation of clean experiments with plutonium fueled assemblies is presented. Simplification approximations of the transport equation and cross section data are evaluated. Associated errors are predicted. Critically safe masses and dimensions are presented for aqueous $Pu(NO_3)_4$ solutions and ^{239}Pu–water mixtures. A theory–experiment comparison is presented. Calculated eigenvalues are tabulated as a function of S_N order and as a function of anisotropic scattering order. NSA

N68-12465# Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.
DESIGN, FABRICATION, AND OPERATION OF THE CVTR HIGH POWER, HIGH-BURNUP TEST ASSEMBLIES

M. G. Balfour, E. S. Foster, H. M. Ferrari, E. Paxson, J. D. Kortheuer (Carolinas Va. Nucl. Power Assoc., Inc.) et al Jun. 1967 102 p refs Prepared for Carolinas Va. Nucl. Power Assoc., Inc.
(Contract AT(30-1)-2289)
(CVNA-274) CFSTI: HC $3.00/MF $0.65

Four special test assemblies were designed to achieve high power levels and burnups beyond the present conservative operating limits for power reactors. Each test assembly consists of six UO_2 rods and 13 dummy Al_2O_3 rods, clad with either freestanding or thin-wall Zircaloy-4 and alternatively with stainless steel. The UO_2 rods were designed for 25.08 and 20.90 kW/ft and peak burnups of 50,000 and 41,670 MWD/MTU, respectively. A detailed description of the test assemblies from the standpoint of irradiation, mechanical, thermal and hydraulic, and nuclear design is given. Fabrication of the assemblies is reviewed. An operation history for the assemblies is presented. Three of the four test assemblies developed defects, and irradiation was terminated prematurely. An analysis of cladding behavior of the assemblies based upon their power history has been performed. Author (NSA)

N68-12466# Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.
PERIODIC ULTRASONIC INSPECTION OF CVTR PRESSURE TUBES
E. Paxson, L. P. Hornak, and M. B. Jones (Carolinas Va. Nucl. Power Assoc., Inc.) Jun. 1967 53 p refs Prepared for Carolinas Va. Nucl. Power Assoc., Inc.
(Contract AT(30-1)-2289)
(CVNA-288) CFSTI: HC $3.00/MF $0.65

The design, fabrication and use of equipment to perform nondestructive examinations, using ultrasonic techniques, of irradiated CVTR Zircaloy-4 pressure tubes at intervals during plant life are summarized. The results of examination of 10 irradiated and 8 unirradiated pressure tubes indicated that the CVTR pressure tubes operated entirely satisfactorily. Author (NSA)

N68-12468# Zentralstelle fuer Atomkernenergie-Dokumentation, Frankfurt am Main (West Germany).
BIBLIOGRAPHIES IN NUCLEAR SCIENCE AND TECHNOLOGY. SECTION 18: ACCELERATORS [BIBLIOGRAPHIEN ZUR KERNFORSCHUNG UND KERNTECHNIK. SEKTION 18: BESCHLEUNIGER]
W. Mausberg, comp. Dec. 1966 106 p refs In GERMAN and ENGLISH
(AED-C-18-09)

A bibliography of 390 references on various aspects of particle accelerators is presented. Included also are author, patent, report number, and subject indexes. NSA

N68-12472# Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
IN-PILE CORROSION OF NUCLEAR MATERIALS Quarterly Report, 1 Sep.–30 Nov. 1966
30 Nov. 1966 41 p
(Contract EURATOM-055-65-3-TEEB(RD))
(EURAEC-1825; EUR-3354; QR-6)

The radiolysis of aqueous solutions was followed by recording the potential E_{Pt} of Pt versus a Ag/AgCl reference electrode during and after γ irradiation. Then the influence of these radiochanged solutions on steel electrodes was measured by recording the open-circuit potential E_{SS} versus time. Widely varying corrosion conditions were thus obtained. Work has been extended to measurements on steel during irradiation and at higher temperature and to neutron irradiation experiments on the solutions as well as on the steel electrodes. Potentiokinetic polarization curves in γ irradiated solutions served to locate the regions of activity and passivity. Another studied variable has been the velocity of the solution. Static and dynamic tests have been compared. Systematically all the results and data obtained are presented, but without any interpretation. Author (NSA)

N68-12475 Societe Belge pour l'Industrie Nucleaire, Brussels (Belgium).
USE OF PLUTONIUM AS FUEL IN NUCLEAR POWER REACTORS [EMPLOI DU PLUTONIUM COMME COMBUSTIBLE DANS LES REACTEURS NUCLEAIRES] Annual Report, 1966
H. Bairiot, A. Lhost, and R. Delrue EURATOM Oct. 1967 91 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-001-64-1 TRUB)
(EUR-3380.F; EURAEC-1884) CFSTI: $3.00

Studies have continued on the technique of vibrating mixed UO_2–PuO_2 powders, containing plutonium in the fine-fraction only. One of the main achievements was the fabrication of plutoniferous rods and their irradiation in the BR-3/PWR reactor. A method of preparing high-density mixed (U, Pu)O_2 grains was selected. Green powder sintering will be used for the moment, but this method is costly and will be abandoned as soon as another technique suitable for plutonium has been perfected. A fuel assembly of the BR-3/VULCAIN type consisting of 18 rods enriched to 6% and one rod enriched to 5% fissile plutonium (Pu-239 + Pu-241), and supplemented with rods supplied by the UKAEA, was chosen from assemblies of the VULCAIN type to evaluate the behaviour of plutoniferous elements in power reactors. The performance of a non-destructive method of determining plutonium distribution by the gamma emission from Pu-239 was evaluated. Two series of irradiations were performed in the hydraulic conveyer HR-1 of the BR-2 reactor, with the aim of studying the thermal behavior of UO_2–PuO_2 fuels. Various methods of determining the burn-up of nuclear fuels were investigated. Author

N68-12479 United Kingdom Atomic Energy Authority, Risley (England). The Reactor Group.
FUEL MANAGEMENT STUDIES FOR THE DUNGENESS B REACTOR
D. E. Billington and M. H. Dean 17 Feb. 1967 28 p ref
(TRG-1424(R)) HMSO: 3s 6d

The results are presented of an investigation of the problem of controlling the radial form factor, in the quarter core of the Dungeness 'B' reactor, using a sophisticated version of the fuel management program, ODYSSEUS, known as ODYSSEUS 2A. The emphasis has been not only on producing improved results for the given situation but also on developing decision-making routines to automate the program which can then be used in assessing other problems in fuel management. The results show that the radial power form factor is maintained well below 1.30 for most of the range although the level does tend to be high over the early part. A form factor of 1.28 could be held relatively easily. The discharge irradiation limiters in this version of ODYSSEUS have been successful in removing low discharge irradiation although a further modification to the program is necessary to eliminate the excessively high irradiations obtained in some channels. The feasibility of controlling the approach to equilibrium for the Dungeness 'B' reactor by fuel manoeuvres alone is thus demonstrated. Author

N68-12509# Atomics International, Canoga Park, Calif.
FEASIBILITY STUDY OF A 1000-MWE SODIUM-COOLED FAST REACTOR. VOLUME 2: RESEARCH AND DEVELOPMENT PROGRAM
Jul. 1966 68 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-11378, V. 2) CFSTI: HC $3.00/MF $0.65

Program needs are delineated for the development of fast reactor technology to the point where 200 to 300 MW(e) prototype can be built and operated. Overall requirements are presented for

concept development, safety and physics, mechanical equipment developments and tests, sodium components and technology, fuel element technology, and fast test reactors. NSA

N68-12532# Argonne National Lab., Ill.
REACTOR DEVELOPMENT PROGRAM Progress Report, Jul. 1967
31 Aug. 1967 157 p refs
(Contract W-31-109-ENG-38)
(ANL-7357) CFSTI: HC $3.00/MF $0.65

This progress report for the nuclear reactor development program covers a wide variety of research activities in reactor physics, reactor technology, reactor control, nuclear fuel elements, reactor design, reactor safety factors, etc. G.G.

N68-12533 Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
PRODUCTION OF HEAVY ELEMENTS BY IRRADIATION OF AMERICIUM-241 IN THE BR 2 REACTOR [PRODUCTION D'ELEMENTS L'OURDS PAR IRRADIATION D'AMERICIUM 241 DANS LE REACTEUR BR 2]
W. Hebel Brussels EURATOM Sep. 1967 28 p refs In FRENCH
(Contract EURATOM-006-60-5 BRAB)
(EUR-3560.F) CFSTI: $3.00

The aim is to review some of the problems encountered in the production of heavy elements by irradiation with americium-241. An examination is made of the application of criteria to an irradiation program to be carried out in the BR 2 high-flux test reactor. The first part of the report discusses the problems raised by an americium irradiation program, especially the activity of non-irradiated targets, the production of heat and the formation of gaseous products. The second part concerns the production of heavy elements in nuclear reactors with thermal neutron fluxes of several times $10^{14} n/cm^2/sec$. Author

N68-12539# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
UO_2-PuO_2 FUEL RODS FOR THE EXPERIMENTAL BOILING WATER REACTOR
R. E. Sharp and W. J. Bailey 5 Jul. 1967 48 p refs Presented at the 1967 Ann. Winter Meeting of the Am. Soc. of Mech. Engr., Pittsburgh, 12–17 Nov. 1967 Submitted for publication
(Contract AT(45-1-1830)
(BNWL-SA-1139(Rev.); CONF-671101-2(Rev. A)) CFSTI: HC $3.00/MF $0.65

The first Pu-fueled boiling water reactor to deliver useful electrical power was the Experimental Boiling Water Reactor. The 36 central core assemblies contained 1296 vibrationally-compacted, Zircaloy-clad, UO_2-1.5 wt % PuO_2 fuel rods (31 lb of Pu, total). The EBWR Plutonium Recycle Demonstration Experiment required preparation of 2250 rods for core and physics tests and included over 1870 kilograms of impacted mixed oxide and over 11,000 feet of fuel rods. Author (NSA)

N68-12540 European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.
THE CODES COSTANZA FOR THE DYNAMICS OF LIQUID-COOLED NUCLEAR REACTORS
G. Forth and E. Vincenti Brussels Oct. 1967 113 p
(EUR-3633.e) CFSTI: $3.00

The two codes COSTANZA cylindrical and COSTANZA axial, written in FORTRAN-H for IBM 360/65, solve the kinetics diffusion equations in two groups and one dimension (plane geometry for COSTANZA axial, radial geometry for COSTANZA cylindrical). The neutronic calculation is coupled with the calculation of the heat transmission from the fuel to the cladding and to the coolant, and with the thermohydraulics of channels with forced circulation of liquid coolant. The geometry of fuel element and channel may be cylindrical or slab. Up to ten groups of delayed neutrons are allowed. Temperature feedback of fuel (Doppler) and coolant are considered independently and affect the nuclear constants. Control rod movement or diffused poison concentrations are simulated by externally imposed variations of the thermal absorption cross section in the different regions of the reactors. Inlet temperatures and mass flow in the coolant channels may be varied according to any externally given time table. Author

N68-12541# Massachusetts Inst. of Tech., Cambridge. Dept. of Nuclear Engineering.
USE OF A PULSED NEUTRON SOURCE TO DETERMINE NUCLEAR PARAMETERS OF LATTICES OF PARTIALLY ENRICHED URANIUM RODS IN HEAVY WATER
H. E. Bliss, I. Kaplan, and T. J. Thompson Sep. 1966 210 p refs
(Contract AT(30-1)-2344)
(MIT-2344-07; MITNE-73) CFSTI: HC $3.00/MF $0.65

The pulsed-neutron technique was used to determine the nuclear parameters of a number of subcritical lattices of slightly enriched uranium metal rods in heavy water. Experimental values of the fundamental mode decay constant λ and geometric buckling B^2 were related to the multiplication factor k_∞ and the absorption cross section by a two-group model. The thermal diffusion area was also obtained. The values of k_∞ are generally in agreement, within experimental uncertainties, with values obtained with the method of added absorbers, with the four-factor formula, and with the two-group critical equation. Known systematic sources of error presently limit the accuracy of the pulsed neutron method to between 1.0 and 1.5%. Measurements were made in two-region assemblies; the values of k_∞ obtained in the test region agree, within experimental uncertainties, with those obtained with the four-factor formula in lattices composed entirely of the test region medium. Author (NSA)

N68-12553# Oak Ridge National Lab., Tenn.
COMPARATIVE EVALUATION OF SOL-GEL FUEL FABRICATION COSTS
T. N. Washburn, A. L. Lotts, and F. E. Harrington Sep. 1967 55 p refs Presented at the CNEN Symp., Turin, 2–3 Oct. 1967
(Contract W-7405-ENG-26)
(ORNL-TM-1979; CONF-671008-2) CFSTI: HC $3.00/MF $0.65

Estimates were made of the costs of fuel preparation and fabrication of sol-gel metal-clad $(U,Pu)O_2$ fuel elements. Four processes were compared, and their costs, including hardware, were: low-energy packing of microspheres, $331/kg; vibratory compaction, $337/kg; pelletizing, $342/kg; and sol-gel extrusion, $331/kg for 0.220-in.-dia UO_2-18% PuO_2 These costs include only the plant operating expenses and capital charges at a fixed annual rate of 22%. The hypothetical plant produces 500 kg of core fuel per day to support a fast reactor industry of 15,000 MW(e). Costs of fuel material, fuel losses, inventory, and scrap recovery were not included, since they are the same for all the processes. Projected technology indicates little economic difference among the four processes, and each could be an excellent contender for production of fast reactor fuel. Continued development is needed to define more adequately the technical and economic capabilities and limitations of the four methods. Author (NSA)

N68-12556# Southwest Research Inst., San Antonio, Tex.
INFLUENCE OF NEUTRON IRRADIATION ON THE PROPERTIES OF STEELS AND WELDS TYPICAL OF THE ERR PRESSURE VESSEL
E. B. Norris 24 Jan. 1967 90 p refs
(Contract AT(11-1)-1228)
(SWRI-1228P4-28; Rept.-4) CFSTI: HC $3.00/MF $0.65

As a part of the Elk River Reactor surveillance program, a study was made of the effects of neutron irradiation on the tensile, impact, and fatigue properties of steels and welds typical of those in the Elk River Reactor pressure vessel. The test specimens utilized in this study were exposed to neutron dosages equivalent to that which the vessel will receive after 3.0 full power years of operation. The results of tests on irradiated tensile and fatigue specimens are compared to the unirradiated properties. Charpy V notch impact curves were determined for irradiated materials so that the shift in the transition temperature of the ERR pressure vessel could be estimated. Author (NSA)

N68-12578# General Dynamics Corp., San Diego, Calif. General Atomic Div.

LATTICE PHYSICS STUDIES Quarterly Progress Report, Period Ending Jun. 30, 1967

G. D. Trimble, T. Gozani, and C. A. Preskitt 10 Jul. 1967 49 p refs

(Contract AT(04-3)-167)

(GA-8114; EURAEC-1903) CFSTI: HC$3.00/MF$0.65

The experimental studies at the Lattice Experimental Facility (LEF) are presented. These include: comparative studies on detector systems for use with LEF, an efficiency determination of the collimator system, thermal neutron spectral measurements in an aqueous solution of $Er(NO_3)_3$, thermal neutron spectral measurements in small U rods, neutron conservation tests in $Er(NO_3)_3$, computational procedures for analysis of single rod and lattice experiments, and pre-analysis lattice cell spectrum measurements. Results are given. NSA

N68-12594# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).

EQUIVALENCE RELATIONS FOR HETEROGENEOUS REACTOR SYSTEMS

A. Keane and M. H. McKay Dec. 1966 12 p refs Sponsored in part by the Australian Inst. of Nucl. Sci. and Eng.

(AAEC/E-168)

A derivation is given of an equivalence relation between heterogeneous and homogeneous systems, which allows for close-packing without the need for a Dancoff correction and which includes fuels dispersed in granular form. An alternative derivation of the equivalence relation is also presented, giving insight into the physical significance of the rational approximation. Author (NSA)

N68-12595# Los Alamos Scientific Lab., N. Mex.

CORRELATIONS OF EXPERIMENTS AND CALCULATIONS

William R. Stratton [1966] 43 p refs Presented at the Am. Nucl. Soc., Natl. Topical Meeting, Nucl. Criticality Safety, Las Vegas, Nev.

(Contract W-7405-ENG-36)

(LA-DC-8386; CONF-661206-3) CFSTI: HC$3.00/MF$0.65

A theoretical technique to interpret critical data using one-dimensional codes for spheres, slabs, and infinite cylinders of ^{235}U, ^{233}U, and ^{239}Pu was compared with data determined experimentally. Calculations for highly enriched ^{235}U thermal and fast systems, even though cross sections for fast and epithermal cores were chosen, gave satisfactory results. A tendency for progressive overestimates of critical radii with decreasing enrichment was seen. A trend of increasing error with decreasing $H/^{235}U$ ratio for systems enriched to 5% ^{235}U or less was noted. For a given ^{235}U enrichment, a calculational bias may be determined and applied with confidence. NSA

N68-12597# Los Alamos Scientific Lab., N. Mex.

TRANSFER FUNCTIONS FOR CIRCULATING-FUEL REACTORS

B. J. Henderson and G. L. Ragan May 1967 16 p refs

(Contract W-7405-ENG-36)

(LA-3734) CFSTI: HC$3.00/MF$0.65

The zero-power transfer function, the power feedback transfer function, and the total reactor transfer function have been determined analytically for a direct-contact, circulating-fuel reactor. Decay and extraction of delayed neutron precursors in the loop outside the core, and the variation of the coolant temperature in this loop are considered. A Fortran-II program has been coded for the IBM 704, and graphs present the results of some parametric studies. The analytic expressions are applicable to circulating-fuel reactors in general, but the parameter values used in the studies reported here are based on conceptual direct-contact reactor designs. Author (NSA)

N68-12606# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik.

SPECIAL EXPERIMENTAL TECHNIQUES DEVELOPED RECENTLY FOR APPLICATION IN FAST ZERO POWER ASSEMBLIES

A. Bayer, H. Seufert, and D. Stegemann Aug. 1966 41 p refs Presented at the Intern. Conf. on Fast Critical Expt. and Their Analysis, Argonne, Ill., 10–13 Oct. 1966

(KFK-474; CONF-661019-9)

Three different experimental methods are described for application in fast zero power assemblies. The first method is for the absolute determination of ^{236}U capture rates. The principle is based upon the fact that ^{243}Am and ^{239}U decay via ^{239}Np into ^{239}Pu. The α-disintegration rate of ^{243}Am is determined absolutely by low geometry α-particle counting. From this the absolute ^{239}Np disintegration rate follows directly, which is measured by the 106 KeV γ-x-ray coincidence technique, so avoiding radiochemical separation. The γ-x-ray self-attenuation within thick U foils is treated quantitatively and an optimum foil thickness is derived. The second method is concerned with the application of resonance activation foils in the KeV-region, where, besides ^{23}Na, the application of ^{19}F and ^{27}Al was found to be interesting. The short half lives of 11.5 sec (^{20}F) and 2.3 min (^{28}Al) require an automatic rabbit-irradiation system by which the irradiated foils were transported immediately between two detectors so that counting could be started 3 sec after the end of irradiation. The third method is used to determine the prompt neutron decay constant, the reactivity, and the absolute reactor power by investigation of the neutron noise. The probability distribution of detector counts in given time intervals is measured by a probability distribution analyzer. The specific feature of this technique is that the complete probability distribution of interest can be measured at once. NSA

N68-12610# Oak Ridge National Lab., Tenn.

CHARACTERIZATION OF ARMY PM-1 TYPE REACTOR FUEL ELEMENTS

D. O. Hobson, V. O. Haynes, and R. S. Crouse Dec. 1966 44 p refs

(Contract W-7405-ENG-26)

(ORNL-TM-1676) CFSTI: HC$3.00/MF$0.65

Results are presented of the characterization and evaluation of a number of PM-1 type, stainless steel-UO_2 fuel elements to better define the as-manufactured physical characteristics of the elements and to provide data for comparison with elements in the postirradiated condition. The primary objectives attained in this study were quantitative information on cladding-fuel bonding and cladding-fuel interface contamination, fuel particle stringering and fragmentation, and cladding grain size. Other information concerning fuel homogeneity and density is included. Some analyses of the probable causes of observed defects are presented. The fuel tubes were judged to be of consistent high quality with the fuel particles well dispersed in the matrix. Although severely fragmented, the particles were stringered very little. Core density was uniformly

around 96% of theoretical. Despite a large amount of particulate contamination between the cladding layers, grain growth had occurred across nearly all of the interfaces. The cladding grain size ranged from ASTM-2 to ASTM-5. Author (NSA)

N68-12613# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.

SPECTRAL INDEX AND RELAXATION LENGTH DETERMINATIONS IN BORATED D_2O AND H_2O

N. P. Baumann, P. B. Parks, and D. J. Pellarin [1967] 21 p refs Presented at the IAEA Symp. on Neutron Thermalization and Reactor Spectra, Ann Arbor, Mich., 17–21 Jul. 1967

(Contract AT(07-2)-1)

(DP-MS-67-10; CONF-670707-1) CFSTI: HC$3.00/MF$0.65

Spectral index measurements with paired Lu–Cu and ^{239}Pu–Mn foils were used to determine the thermal-neutron energy equilibria in boron-poisoned H_2O and D_2O. The results were found to depend not only on the amount of poison and the diffusion properties of the moderator but also on the type of neutron source feeding the experimental samples. Thermal neutrons ("space" feed) were obtained from a thermal column of a reactor. Epithermal neutrons (slowing-down or "energy" feed) were supplied by leakage neutrons from the same reactor or from a neutron generator supplying 14-MeV neutrons. For both H_2O and D_2O the experimental spectral index is much larger for energy feed than for space feed. Monte Carlo calculations using the Brown–St. John (BSJ) kernel and THERMOS computations using both the BSJ kernel and Honeck's adaption of the Nelkin kernel were in close agreement with each other and with the experiments when the source feed was properly characterized. The cause of the spectral index variation with source conditions is not the same for the two moderators. Detailed examination of the computations suggest that this difference for D_2O is largely ascribable to a true difference in the Maxwellian distribution whereas for H_2O the difference is almost entirely due to subcadmium epithermal (1/E activations. The measurements in D_2O were extended to high boron concentrations in order to ascertain the observable effects of a formal limit to equilibrium conditions when the neutron diffusion length, L, approached $1/\Sigma_a$. If the source feed neutrons are at the normal neutron temperature of 20°C, relaxation-length measurements suggest an approach to equilibrium near the interface, but the spectral index measurements indicate that spectral hardening continues deep into the sample, i.e., that equilibrium is not obtained. However, when 1/v-law filters were interposed between the source and the diffusing medium to harden the spectrum to the equilibrium value computed by THERMOS no spatial dependence was observed for relaxation lengths or spectral indices over the entire experimental range. This result indicates that the effects of the formal limit are not always readily experienced and thus the limit must be re-expressed in terms of effective energy cutoff limits in order to be experimentally observable. Author (NSA)

N68-12635# Harvard School of Public Health, Boston, Mass. Harvard Air Cleaning Lab.

THE "DIFFUSION BOARD" CONCEPT IN REACTOR CONTAINMENT

Parker C. Reist, Melvin W. First, and Leslie Silverman 1 Sep. 1966 46 p refs

(Contract AT(30-1)-841)

(NYO-841-6) CFSTI: HC$3.00/MF$0.65

In an effort to develop a suitable diffusion board for application to problems of reactor containment, the Harvard Air Cleaning Laboratory staff has investigated a number of materials. These include a carbon-impregnated cellulosic fiber, a rigid porous carbon material, special boards constructed from slagwool and glass fibers, an aluminum honeycomb structure (the so-called Harvard Diffusion Board), and a porous-lined mineral-fiber ceramic board. Although certain of the media possess the required efficiency for removing particulate radioactivity and iodine vapors, all have proven to be deficient in one or more basic aspects, the major one being the problem of steam clogging. Although this can be overcome using preheated metallic filters (for example, copper wool), such an approach is not practical for application under emergency conditions. Future studies directed to the solving of this problem include the use of special methods to prevent wetting of the adsorbents and filters. Also under consideration is the possibility of incorporating into the board certain chemicals that would (upon contact with steam) release substantial quantities of heat (such as the heat of solution, crystallization, etc.). Author (NSA)

N68-12636# Los Alamos Scientific Lab., N. Mex.

SHIELD ANALYSIS OF AN EXPERIMENTAL FAST REACTOR

Donald J. Dudziak and M. E. Battat [1967] 23 p refs Presented at the Intern. Conf. on the Phys. Probl. of Reactor Shielding, Harwell, England

(Contract W-7405-ENG-36)

(LA-DC-8538; CONF-670932-1) CFSTI: HC$3.00/MF$0.65

A method of analysis to determine the detailed spatial distribution of neutron and γ-ray absorbed doses external to the fast core Los Alamos Molten Plutonium Burnup Experiment is presented. The neutron codes CRAM and DDK were used for diffusion theory and S_4 transport-approximation calculations. In the calculations of γ-ray energy deposition, point-kernel integration and Monte Carlo methods were used. NSA

N68-12660# Argonne National Lab., Ill.

SOLUTION OF THE PROBLEM OF ANALYTICALLY CONSTRUCTING AN OPTIMAL REGULATOR FOR A NUCLEAR POWER INSTALLATION [O RESHENII ZADACHI ANALITICHESKOGO REGULYATORA DLYA YADERNOI]

N. M. Sokolova [1967] 11 p refs Transl. into ENGLISH from Vestsi Akad. Navuk Belarusk. SSR, Ser. Fiz.-Tekh. Navuk (Minsk), no. 3, 1965 p 21–28

(ANL-Trans-470) CFSTI: HC$3.00/MF$0.65

An optimal-control system for a nuclear installation consisting of a reactor, regenerator, cooler, and turbine compressor is developed. The partial differential equations of the system are reduced to ordinary differential equations by averaging the parameters of the length of the heat exchangers with subsequent establishment of a connection between the average gas temperature and the inlet and outlet temperatures, in the form of a uniformly converging series. Means of designing a programming element that develops the optimal program for the system, and an optimal regulator capable of following the specified program and correcting the operation of the system are discussed. By way of an example, a simple program aimed at maintaining a system in the stationary condition is analyzed mathematically. A similar method can be used to control a specified change in output power, to ensure cooling of the reactor within a minimum time, and other control operations. The connection between the dynamic programming as described in the paper and Lyapunov functions is briefly indicated. NSA

N68-12675# Imperial Coll. of Science and Technology, London (England). Nuclear Power Group.

NEUTRON DIFFUSION AND MULTIPLICATION IN REACTOR LATTICES

Muhammad Rafiq Haroon (Ph.D. Thesis) Sep. 1966 378 p refs

(NP-16953)

Neutron flux distribution and buckling measurements were made as a function of fuel loading in a subcritical assembly. The measurements were made in a square configuration. Control rod effectiveness measurements were also made. Results were correlated on the basis of diffusion theory. Values for k_∞ and B_m^2

are shown as a function of number of fuel elements; reflector savings are plotted as a function of reflector thickness. Analysis of control rod effects is based on super-cell calculations and the heterogeneous theory. NSA

N68-12676# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Radiochemie.

PRODUCTION OF FUEL ELEMENTS FOR IRRADIATION IN EFFBR. PART 1: FUEL PRODUCTION [HERSTELLUNG VON BRENNELEMENTEN ZUR BESTRAHLUNG IM EFFBR. TEIL 1: BRENNSTOFFHERSTELLUNG]

Th. Dippel and K. H. Walther Mar. 1967 8 p In GERMAN

(KFK-564)

The preparation and production for fast reactor fuel element fabrication is presented. Preparation procedures are outlined; chemical processing for the fuel material is discussed. A materials balance for the production process is given. NSA

N68-12677# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

DEVELOPMENT OF MATHEMATICAL MODELS OF PRESSURE-TEMPERATURE TRANSIENTS IN REACTOR CONTAINMENT SYSTEMS DURING A LOSS-OF-COOLANT

B. M. Johnson 23 Sep. 1966 19 p refs Presented at the Pacific Northwest Reg. Meeting, Richland, Wash. and at the Symp. on the Impact of Low Cost Nucl. Power and Chem. Ind., Houston, Tex., Sep. 1966

(Contract AT(45-1)-1830)

(BNWL-SA-844; CONF-661025-4; CONF-670201-3) CFSTI: HC $3.00/MF $0.65

The development of mathematical models for predicting pressure and temperature transients that exist in the Containment System Experiment are outlined. The scope and purpose of the program, which investigates nuclear safety questions arising from potential reactor accidents, is first described. The models for transient conditions were developed with the aid of the Modified Integral Digital Analogue Simulation code (MIDAS) which provides a convenient method of solving sets of simultaneous differential equations. Examples of the results and the advantages and disadvantages of the use of the MIDAS code are discussed. Author (NSA)

N68-12683# General Dynamics Corp., San Diego, Calif. General Atomic Div.

PHYSICS PERFORMANCE OF THE PEACH BOTTOM HTGR

J. Brown, G. Hopkins, R. Lane, M. Merrill, and K. Van Howe 17 Jul. 1967 18 p refs Presented at the Am. Nucl. Soc. 1967 Conf. on Reactor Operating Experience, Atlantic City, 23-26 Jul. 1967

(Contract AT(04-3)-314)

(GA-8117; CONF-670713-8) CFSTI: HC $3.00/MF $0.65

During the startup of the Peach Bottom HTGR, measurements were made of the physics performance of the reactor core. Physics measurements were performed during the initial loading of fuel and at low reactor powers (<11.5 kW(t)). The results of these low power tests agreed well with calculated physics performance of the reactor. Initial criticality was achieved with 682 fuel elements loaded compared with a calculated value of 686 fuel elements. The total reactivity worth of control rods was measured by pulsed neutron technique. The measured control rod worths were in good agreement with the calculated worths. For example the measured worth of the control rods in the central rod ring in the just critical core was 0.0222 ± 0.0014 $\Delta\rho$ compared to a calculated worth of 0.0224 $\Delta\rho$. The flux distribution within the core was measured by traversing a BF_3 chamber in the coolant channels between the fuel elements. As fuel was loaded to the full core loading of 804 fuel elements, differential and total control rod worths were measured by positive period measurements. The results of these measurements agreed with the pulsed source measurements and the calculated rod worths. The measured worth of the three control rods in the central ring was 0.0213 $\Delta\rho$. The reactivity effects of He density and He flow were measured. The temperature coefficient of reactivity from 100°F to 600°F was measured by using the heat input of the He circulators to increase the core temperature. During the low power tests (<11.5 kW(t)) noise analysis measurements were made at various He flow rates through the core. During the escalation of the reactor power from 11.5 kW(t), additional measurements were made. As the reactor power level was increased, measurements of critical control rod positions and fuel element temperatures were made to determine the temperature coefficient of reactivity at operating temperatures. The results of these measurements confirm the agreement between the measured and calculated temperature coefficient obtained at temperatures up to 600°F during the low power test. During power operation, control rods were calibrated using an on-line reactivity computer. The build-up and decay of Xe poisoning following power level changes were also measured. Noise analysis measurements were made at various power levels by recording the output of the power range nuclear channels on magnetic tape. A frequency analysis of these recordings was performed to determine if any resonant frequencies exist in the range from 0.1 to 100 cps. Author (NSA)

N68-12685# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.

DEVELOPMENT AND CORRELATION OF A METHOD FOR GENERATING SPACE DEPENDENT MULTIGROUP EFFECTIVE CORE CROSS SECTIONS FOR 710 REACTOR ANALYSIS

W. B. Henderson 25 Sep. 1967 71 p refs

(Contract AT(40-1)-2847)

(GEMP-548) CFSTI: HC $3.00/MF $0.65

A method was developed in support of the 710 Reactor Program for generating space-dependent multigroup effective core cross sections. The effective core cross sections, computed in up to 40-zone spatial detail from Doppler broadened Breit-Wigner cross sections, not only improve the accuracy of power distribution calculations where resonance self-shielding is important but also provide a means of computing the Doppler coefficient of reactivity. The method relies on a synthesis of the detailed space-energy core flux distribution from parametric flux traverses generated by a monoenergetic transport approximation. The approximation is primarily in the use of a trial source in the core, for which a correction is subsequently made using the synthesized flux. Errors in zone flux-weighted core cross sections due to the method of flux synthesis were estimated to be 5% or less by comparisons with a 32-group transport calculation of a typical W resonance in the core of the 710 Basic No. 1 critical experiment, a small Oralloy-tungsten core radially reflected by thick Be. Correlation with experimental power distributions and spectral indicators, using the effective multigroup core cross sections in two-dimensional r-z transport calculations, was generally within experimental error and the critical Oralloy density was underpredicted 3%. The largest effect of detailed zone flux-weighting as opposed to flat lethargy-flux weighting of the core cross sections was an 18% increase in the power gradient at the radial core surface. Author (NSA)

N68-12680# Oak Ridge National Lab., Tenn.

A PRELIMINARY INVESTIGATION OF LOW-TEMPERATURE, LIGHT WATER-COOLED AND MODERATED, SLIGHTLY-ENRICHED URANIUM METAL FUEL REACTORS FOR LARGE SINGLE-PURPOSE NUCLEAR DESALTING PLANTS

R. H. Chapman and E. H. Gift Dec. 1966 41 p refs

(Contract W-7405-ENG-26)

(ORNL-TM-1152, Rev.) CFSTI: HC $3.00/MF $0.65

Low-temperature, light water-cooled and moderated, slightly enriched U metal fueled reactors show significant savings in capital and fuel cycle costs in relatively large, single-purpose desalting plants. A preliminary study was performed to determine current fuel limitations and approximate heat costs. Reactors of 1500 and 3500 MWt, sufficient for producing 150 and 350 Mgd of fresh water, respectively, when coupled to water plants having performance ratios of about 10, were studied. With reactor coolant temperatures in the range of 250 to 350°F, significant savings in reactor plant capital costs result from the low pressure required to suppress boiling and the relatively low energy content of the coolant to be contained. This temperature range also permits direct coupling of the water plant to the primary coolant circuit through the brine heaters, thus eliminating the cost of an intermediate heat transfer system. The effects of density and self-shielding of lumped uranium metal in relatively dry lattices are to increase the fast fission effect and the conversion ratio, resulting in higher neutron economy and lower fuel cycle cost. Fuel cycle costs will be in the range of 4.40 to 5.90 cents/mBtu for the 1500 MW(t) reactor and 3.85 to 5.40 cents/mBtu for the 3500 MW(t) reactor. The range is reported to reflect uncertainties in the physics calculations and burnup level. Thus it is expected that heat cost will be in the range of 13.5 to 15.5 cents/mBtu for the 1500 MW(t) reactor and 10.0 to 11.5 cents/mBtu for the 3500 MW(t) reactor. Author (NSA)

N68-12697# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
STUDY OF THE SHAPING AND IRRADIATION OF URANIUM CARBIDE Quarterly Report, Jan. 1–Mar. 31, 1966
J. Devillard and G. Morlot 31 Mar. 1966 32 p Sponsored by EURATOM
(EURAEC-1763; EUR-3318; QR-19) CFSTI: HC $3.00/MF $0.65

The facility designed for irradiation of 8% enriched uranium carbide at 1000°C required alteration to eliminate the strong convection phenomena, which brought irradiation Sil 2 to a premature halt. Technical specifications for the facility for the nonisothermal irradiation of uranium carbide are defined. Such irradiation will make it possible to irradiate fuel pins with a conductivity integral close to 100 W/cm. Author (NSA)

N68-12699# Union Carbide Nuclear Co., Oak Ridge, Tenn. Gaseous Diffusion Plant.
ORGDP FUEL REPROCESSING STUDIES Progress Report, Period Ending Oct. 31, 1966
S. H. Smiley 20 Jan. 1967 28 p refs
(Contract W-7405-ENG-26)
(K-L-1780, Pt. 17) CFSTI: HC $3.00/MF $0.65

Developments in scale-up and component and engineering studies are reported. Major emphasis in semiworks operation was the oxidation step in the reactor facility. Other component work included performance testing of filters in volatility process corrosive atmospheres, sampling studies using equipment potentially suitable for large amounts of solids (e.g., to sample the bed of the main reactor), fluidization tests for possible application in separating urano–uranic oxide fines from the bed of the main reactor by elutriation, and a long-term run with the ORGDP peripheral compressor. In low enrichment fuel reprocessing, emphasis was placed on the system analysis program; conceptual plant studies, including equipment sizing; and plans to adapt the semiworks plant for interhalogen fluorination. The major reference flow sheet change involves the use of bromine pentafluoride for the production or uranium hexafluoride which is essentially free of plutonium. NSA

N68-12705# California Univ., Livermore. Lawrence Radiation Lab.
SOME FIRST THOUGHTS ON THE SPR-6 REACTOR CONTROL SYSTEM
M. Grissom 2 Aug. 1967 14 p refs *Its* Space Power Note No. 230
(Contract W-7405-ENG-48)
(UCID-15204) CFSTI: HC $3.00/MF $0.65

A pneumatic servo system and a general logic control scheme are presented as a method for controlling the SPR-6 reactor. Some pneumatic devices utilizing the techniques of fluidic technology are examined. Author (NSA)

N68-12707# Atomic Power Development Associates, Inc., Detroit, Mich.
CYLINDRICAL FUEL ELEMENT FLOW STABILITY PROGRAM
J. J. Edwards, C. H. Brown, Jr., R. J. Clancy, and A. J. Friedland 31 Jan. 1967 173 p refs
(Contract AT(11-1)-865)
(APDA-181) CFSTI: HC $3.00/MF $0.65

The isothermal, hydraulic testing program is concerned with the effect of wire pitch and wire diameter on the coolant pressure drop of wrapped-wire supported rod assemblies. Spatial distribution of the velocity head can be used as a basis for structural analysis of wrapped-wire support rod assemblies with geometries similar to Na-cooled fast breeder reactor fuel element configurations. NSA

N68-12709# Copenhagen Univ. (Denmark).
STUDIES OF REACTOR SITING [STUDIER OVER REAKTORPLACERING]
Soeren Thykier-Nielsen 1966 169 p In DANISH
(NP-16793)

Siting of a nuclear power plant in a given area was investigated. The consequences of a major reactor accident were evaluated. The composition and distribution of the population in the area and the meteorological conditions were considered. After examining several spects of the problem a couple of criteria functions were set up. In minimizing these functions, under certain restrictions it will be possible to find the optimal site for a reactor, in the sense that the risk to the population from a fission-product release is minimized. NSA

N68-12718* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MEASUREMENTS ON XENON FILLED NUCLEAR IRRADIATED THERMIONIC DIODES
Ralph Forman Washington 1967 11 p refs Presented at IEEE Thermionic Conf., Palo Alto, Calif., 30 Oct.–2 Nov. 1967
(NASA-TM-X-52377) CFSTI: $3.00 CSCL 18J

The properties of xenon filled thermionic diodes, exposed to nuclear radiation in the core of a 5.0 megawatt nuclear reactor, have been measured. The experimental technique consists of measuring the current–voltage characteristics of a gas-filled tube at increasingly higher radiation levels. The generation of ion–electron pairs in the gas by nuclear radiation results in space charge neutralization effects. Author

N68-12726# General Dynamics Corp., San Diego, Calif. General Atomic Div.
LATTICE PHYSICS STUDIES Quarterly Progress Report, Period Ending Oct. 31, 1966
G. D. Trimble, T. Gozani, and J. M. Neill 25 Nov. 1966 54 p refs
(Contract AT(04-3)-167)
(GA-7562; EURAEC-1821) CFSTI: HC $3.00/MF $0.65

The study of the spatially dependent lattice neutron spectrum for Pu-water lattices is outlined. A two-dimensional transport code, modified to allow printout of directional fluxes, is being used to determine probe-tube perturbations. A Monte Carlo code is being used to compute perturbations due to reentrant holes. The problem

of correlation of calculated and measured fluxes has been studied in detail. Results of these studies are presented. Slowing-down source calculations are presented in some detail. Energy sensitive detectors design is described; these will be used to measure mean emission time. A design is given which is to be used for measuring tightly packed lattices. The joint Euratom experimental program is outlined. NSA

N68-12729# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).

THE MECHANICAL PROPERTIES OF BEO-(UTH)O_2 DISPERSION FUELS

K. Veevers and W. B. Rotsey Aug. 1966 37 p refs

(AAEC/TM-338)

Dispersions of (UTh)O_2 in BeO were fabricated using (UTh)O_2 particles made from mixed powders of UO_2 and ThO_2 or by coprecipitation of UO_2 and ThO_2. The behavior of the dispersions was studied by measuring the modulus of rupture and Young's modulus. Modulus of rupture measurements were made by four-point bending of cylindrical specimens, and Young's modulus was calculated from the deflection of rectangular beams. The out-of-pile control specimens for two irradiation experiments, X121 and X105, were also tested. Examination of matching fracture faces showed that cracks passed through (UTh)O_2 particles, indicating that they were bonded to the matrix. The results were compared with previous results on BeO–ThO_2 dispersions. The strength of dispersions of (UTh)O_2 in BeO decreased with increasing (UTh)O_2 particle size and increasing (UTh)O_2 concentration. NSA

N68-12733# General Electric Co., San Jose, Calif. Advanced Products Operation.

THE EFFECTIVE AXIAL AND DIAMETRAL THERMAL EXPANSION OF UO_2 UNDER A RADIAL TEMPERATURE GRADIENT

R. R. Asamoto, K. J. Perry, and E. L. Zebroski Oct. 1966 49 p refs

(Contract AT(04-3)-540)

(GEAP-5284) CFSTI: HC$3.00/MF$0.65

An out-of-pile investigation was undertaken to determine the thermal expansion characteristics of a column of ceramic fuel pellets. The expansion of dished and nondished UO_2 pellets under the influence of radial temperature gradients was studied under conditions of thermal cycling, at temperatures up to fuel melting (2850°C), and with and without axial restraint of the fuel. The effect of limited radial restraint was also observed using tungsten as cladding. Reduced axial expansion with good expansion stability on thermal cycling was found with properly designed dished pellets. Author (NSA)

N68-12736# Kernforschungzentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung.

CALCULATION PROGRAM FOR THE DYNAMICS AND STABILITY OF A FAST POWER REACTOR [RECHENPROGRAMME FUER DYNAMIK UND STABILITAET EINES SCHNELLEN LEISTUNGSREAKTORS]

W. Frisch and E. Schoenfeld Jun. 1966 97 p refs In ENGLISH and GERMAN Sponsored jointly by US–EURATOM

(KFK-465; EURFNR-206F)

In order to analyze sodium-cooled fast power reactors the present calculation programs were developed for dynamics studies and stability calculations. An analog program permits dynamic studies of the core and the primary coolant system. In this program the most important nonlinearities were considered so that the larger perturbations could be studied. For the stability investigations two FORTRAN programs were available with which various frequency pairs could be calculated which described the transition behavior of the core. Application of this digital program to other coolants as H_2O vapor is possible. Author (NSA)

N68-12737# General Electric Co., Pleasanton, Calif. Vallecitos Atomic Lab.

HIGH PERFORMANCE UO_2 PROGRAM. ALPHA AND BETA–GAMMA AUTORADIOGRAPHY OF HIGH PERFORMANCE PELLET AND POWDER FUEL

B. Weidenbaum, D. H. Coplin, and M. F. Lyons Oct. 1966 79 p refs

(Contract AT(04-3)-189)

(GEAP-5100-7; EURAEC-1888) CFSTI: HC$3.00/MF$0.65

A selected group of α and β–γ autoradiographs obtained routinely during examination of fuel rods irradiated in the PWL with varying degrees of central melting were studied in some detail. The group includes autoradiographs of pellet and powder fuels irradiated to low burnup, and also to extensive burnup, without incident. Autoradiographs are also included of an instance in which molten fuel reached the cladding and one in which perforation of the cladding occurred while the test reactor was being brought to full power. Practical considerations limited the extent to which both techniques could be developed during this program. Even so, the β–γ autoradiographs proved to be useful in obtaining a qualitative picture of fission product distribution within the fuel. Although consideration was given to the possibility of eventually developing procedures to give quantitative significance to the β–γ autoradiographs, there are inherent limitations in obtaining this goal that are imposed by the use of photographic emulsions. Author (NSA)

N68-12738# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik.

FAST BREEDER REACTORS, THEIR PRINCIPLES, THEIR DEVELOPMENT, AND THEIR ROLE IN A NUCLEAR ECONOMY [SCHNELLE BRUTREAKTOREN, IHR PRINZIP, IHRE ENTWICKLUNG UND IHRE ROLLE IN EINER KERNENERGIEWIRTSCHAFT]

Wolf Haefele Oct. 1966 32 p refs Transl. into ENGLISH from German Presented at the Federation for Res. of Nordrhein-Westfalen State, Duesseldorf, 1 Jun. 1966 Sponsored jointly by US–EURATOM

(KFK-480; EURFNR-233F)

The principles, development, and role of fast breeder reactors in a nuclear economy are outlined on the basis of a bibliographic study. The Karlsruhe fast breeder project is discussed in some detail. The studies made in Holland, Belgium, and the United States on fast breeder reactors are briefly indicated. NSA

N68-12743# Oak Ridge National Lab., Tenn.

EXPERIENCE WITH HIGH-TEMPERATURE CENTRIFUGAL PUMPS IN NUCLEAR REACTORS AND THEIR APPLICATION TO MOLTEN-SALT THERMAL BREEDER REACTORS

P. G. Smith Sep. 1967 44 p refs

(Contract W-7405-ENG-26)

(ORNL-TM-1993) CFSTI: HC$3.00/MF$0.65

Design features, development problems, and operating experience have been compiled for liquid-metal and molten-salt circulating pumps used in various nuclear reactors and test facilities. The compilation was made to search out the problem areas and to select suitable combinations of features for the circulating pumps required by each of the three molten-salt systems in the proposed molten-salt thermal breeder reactor. The pumps are divided into two configurations: the "short-shaft pump" and the "long-shaft pump." The short-shaft pump is favored for the coolant salt system, and the long-shaft pump is favored for the fuel-and-blanket salt systems. Author (NSA)

N68-12745# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.

ADVANCED GRAPHITE FUEL SYSTEMS Quarterly Progress Report, Period Ending 14 Feb. 1967

J. C. Bokros, G. B. Engle, R. J. Price, and J. L. White 10 Mar. 1967 50 p refs
(Contract AT(04-3)-167)
(GA-7827) CFSTI: HC $3.00/MF $0.65

Developments are reported for studies on: structure of carbonized coal-tar pitch; characterization of degree of graphitization of C and graphite; influence of pitch-binder content on the properties and irradiation behavior of molded graphite bodies; thermal expansion and preferred orientation of nongraphitic carbons; radio-induced dimensional changes in model carbons and graphites; and annealing of pyrolytic carbon structures. NSA

N68-12749# Battelle Memorial Inst., Columbus, Ohio. Bettis Atomic Power Lab., Pittsburgh, Pa.
THERMAL STABILITY OF ZIRCONIA- AND THORIA-BASE FUELS
Carl A. Alexander, Julius S. Ogden, and George W. Cunningham 6 Jan. 1967 27 p refs Prepared for Bettis Atomic Power Lab., Pittsburgh
(Contracts W-7405-ENG-92; AT(11-1)-GEN-14)
(BMI-1789)

Vapor densities and/or dissociation pressures of UO_2, ThO_2, ZrO_2, ThO_2–8 and –20 wt % UO_2, and ZrO_2–20 and –50 wt % UO_2 were obtained in the range from 2000 to 3000°K by the transpiration technique. The UO_2–ZrO_2 system exhibited marked positive deviation from ideality, indicative of a strong tendency toward immiscibility. The UO_2–ThO_2 system was found to behave almost ideally. On the basis of the vapor pressures of UO_2 and of ThO_2 and the activity values it would be expected that compositions containing 1 mole % or more of UO_2 would volatilize by preferentially losing UO_2. A composition containing slightly less than 1 mole % UO_2 should prove to be the congruently subliming composition. O_2-dissociation pressures were determined for stoichiometric UO_2 and for a composition on either side of the stoichiometric one. At 2360°K, $UO_{2.03\pm0.01}$, $UO_{2.00\pm0.01}$, and $UO_{1.97\pm0.01}$ exhibited O_2-dissociation pressures of 1×10^{-7}, 4.3×10^{-10}, and 3×10^{-12} atm, respectively. From determinations of vapor density and measurements of O_2 pressure, pressure–temperature–composition relations were established for UO_2 over a small range of compositions encompassing $UO_{2.00}$. Author (NSA)

N68-12750# Argonne National Lab., Ill.
REACTOR DEVELOPMENT PROGRAM Progress Report, Nov. 1966
21 Dec. 1966 98 p refs
(Contract W-31-109-ENG-38)
(ANL-7279) CFSTI: HC $3.00/MF $0.65

Items of significant technical progress which have occurred in both the specific reactor projects and the general engineering research and development programs are summarized. Program activities are reported under five broad categories: Plutonium Utilization, Liquid-Metal Fast Breeder Reactors, General Reactor Technology, Advanced Systems Research and Development, and Nuclear Safety. The Experimental Boiling Water Reactor Pu recycle program is discussed under Plutonium Utilization. Liquid-Metal Fast Breeder Reactors includes the Experimental Breeder Reactor-II operations, fast zero-power assembly development, and fast reactor physics, components, and fuels development. General Reactor Technology examines applied and reactor physics, fuels and cladding, engineering, chemistry, and chemical separations. The Argonne Advanced Research Reactor development is summarized under Advanced Systems Research and Development. Nuclear Safety activities include coolant dynamics, fuel meltdown, materials behavior, energy transfer, Pu volatility studies, and TREAT operations. NSA

N68-12760# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
FABRICATION AND IRRADIATION TESTING OF SOL–GEL FUELS AT OAK RIDGE NATIONAL LABORATORY
A. R. Olsen, J. D. Sease, R. B. Fitts, and A. L. Lotts Sep. 1967 55 p refs Presented at the Symp. on Sol–Gel Processes for the Production of Ceram. Nucl. Fuels, Turin, 2–3 Oct. 1967
(Contract W-7405-ENG-26)
(ORNL-TM-1971; CONF-671008-1) CFSTI: HC $3.00/MF $0.65

Alternate procedures under development for fabricating oxide fuels from Sol–Gel process products are reviewed. Procedures include Vi-Pac, the high-energy vibratory compaction of angular particles; Sphere-Pac, the low-energy vibratory compaction of microspheres; powder preparation and pelletizing; extrusion of concentrated sols or clays; and pyrolytic C coating of microspheres. Also reported are compressive creep behavior of ThO_2 pellets, thermal conductivity of ThO_2 and ThO_2–UO_2 pellets and Sphere-Pac ThO_2 beds, and irradiation performance of the various fuel forms. Author (NSA)

N68-12767# Bettis Atomic Power Lab., Pittsburgh, Pa.
PM-2A REACTOR VESSEL TEST: DESCRIPTION OF TESTING AND FAILURE CONDITIONS
J. M. Monahan and T. J. Walker Jan. 1967 81 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-640) CFSTI: HC $3.00/MF $0.65

The second or pressure testing phase of the PM-2A Pressure Vessel Test has been completed. A prescribed pressure-temperature sequencing procedure with intentionally installed defects in the cylindrical portion of the vessel wall resulted in brittle fracture at a lower bound condition. The brittle fracture initiated at the defect at −20°F and 4475 psig internal vessel pressure. This report summarizes the design of the test loop, the development and use of specialized equipment, and the results of the series of pressurization tests. The results of a half-scale model test are included with emphasis on their relation to the full-scale pressurization test. The prediction of failure conditions for a pressure vessel including stress, defect size, and temperature on the basis of fracture mechanics was demonstrated for the unirradiated half-scale test. Author (NSA)

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N68-11975# TRG, Inc., Melville, N. Y.
SPONTANEOUS EMISSION IN THE PRESENCE OF A PRESCRIBED CLASSICAL FIELD
Maurice Newstein Aug. 1967 36 p refs
(Contract AF 19(628)-5111)
(TRG-057-1; AFCRL-67-0510; SR-1; AD-660599)

The effect on the spectrum of spontaneous emission from a simple physical system of the application of a classical driving field is studied. The physical system consists of an ensemble of two level atoms interacting with a relaxation mechanism. The single Lorentzian line shape characteristic of the power spectrum of

spontaneous emission for the undriven case, is split into components by the driving field. This splitting is associated with the establishment of definite phase relations between the corresponding components of the field spectrum. Author (TAB)

N68-12012# Toronto Univ., (Ontario). Inst. for Aerospace Studies.
INSTITUTE FOR AEROSPACE STUDIES ANNUAL PROGRESS REPORT, 1967
Oct. 1967 280 p refs
(Grants AF-AFOSR-276-66; AF-AFOSR-366-66; AF-AFOSR-944-66; DRB-9551-02; DRB-9501-02 et al)

The University's research facilities and achievements are briefly reviewed, and the industry-oriented activities of its staff are reported. Summary data are presented on the 108 research projects being undertaken, which are supported by 10 agencies. These involve the mechanics of rarefied gases; plasma dynamics; hypervelocity flow, implosions, and impact; energy conversion; aerodynamic noise; subsonic aerodynamics; aerospace flight dynamics; materials science and structures; upper atmospheric research; molecular beams and surface interactions; upper atmospheric research; molecular beams and surface interactions; high temperature gas dynamics and gas physics; and industrial and architectural aerodynamics. A bibliography of publications is included. M.G.J.

N68-12094# Hughes Research Labs., Malibu, Calif.
INTERACTION OF COHERENT LIGHT WITH SOLIDS AND WITH TURBULENT ATMOSPHERES Interim Report, 1 Oct. 1966–30 Sep. 1967
Wilbur P. Brown, Jr., and Concetto R. Giuliano Oct. 1967 10 p refs
(Contract AF 49(638)-1607)
(AFOSR-67-2477; AD-660589)

Considerable progress was made on the development of an improved theory and physical model of propagation in turbulent media. Topics studied include (1) the effective refractive index of random media; (2) the statistics of waves propagated in random media; (3) the dyadic Greens functions for vector waves propegated in random media; (4) an extension and generalization of earlier results on the validity of the Rytov approximation; and (5) a geometrical-diffraction theory of optical propagation in random media. As a second and distinct part of the research program, the nonlinear absorption of high intensity radiation was studied. A number of compounds with potential as Q-switch materials were investigated, and a rather complete picture of the mechanism responsible for their behavior has been developed. In addition, the photoisomerization of indigo dyes by giant pulse radiation has been investigated. This work yielded the first direct observation of a short-lived intermediate of a photoisomerization process. Author (TAB)

N68-12118# National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.
THE ICING OF CYLINDERS IN CONDITIONS OF SIMULATED FREEZING SEA SPRAY
J. R. Stallabrass and P. F. Hearty Jul. 1967 35 p refs
(NRC-9782; MD-50) CFSTI: HC$3.00/MF$0.65

Tests carried out in an icing wind tunnel on cylinders of various diameters demonstrate the effect of air temperature and cylinder diameter on the percentage of spray that freezes on the cylinder. Author

N68-12119# Duke Univ., Durham, N. C. Dept. of Electrical Engineering.
A COMPUTER SOLUTION FOR THREE-DIMENSIONAL TIME-INVARIANT, CONSERVATIVE FIELDS
Walter C. Metz, Jr. Jun. 1967 211 p refs Sponsored in part by NSF
(Contract AT(40-1)-2430)
(ORO-2430-37) CFSTI: HC$3.00/MF$0.65

A method of obtaining computer solutions to three-dimensional boundary-value problems involving time-invariant conservative fields is described. A further restriction that these fields exist in an isotropic linear and piecewise-homogeneous medium was imposed although this limitation is not inherent in the basic formulation. The technique is applicable to the Dirichlet, Neumann, and mixed boundary types. The method is based on a surface integral form of Poisson's equation which gives explicitly the potential function at any point in the field. In a given problem, the equation is written for the potential at points on specific surfaces in the field. The resulting set of integral equations is then approximated by a set of linear algebraic equations, the variables being unknowns at points on the surfaces. The simultaneous equations are solved by a digital computer and the solutions substituted in the integral equation to give the potential anywhere in the field. Numerical approximation of a two-dimensional integral equation thus effectively reduces the three-dimensional problem to a two-dimensional problem. The alternate approach of solving difference equations which approximate the differential form of Poisson's equation is impractical for even the most powerful computers. NSA

N68-12185# Sandia Corp., Albuquerque, N. Mex.
A COMPARISON AND EVALUATION OF THE HELIUM PRESSURIZATION AND RADIFLO METHODS OF LEAK RATE DETERMINATION
L. M. Ford Dec. 1966 14 p
(Contract AT(29-1)-789)
(SC-TM-66-2614)

The general theory, calculations, advantages, and disadvantages of the helium pressurization and Radiflo methods of leak rate determinations are discussed. Author (NSA)

N68-12236 India. Dept. of Atomic Energy, Bombay.
TREATMENT OF EXPERIMENTAL DATA
V. R. Nargundkar and K. Subba Rao 1967 54 p refs
(BARC-282) CFSTI: $3.00

The mathematical treatment of observed data is discussed, stressing the fitting of polynomials and tests for the goodness of fit. Various types of errors and their treatment are covered. The fundamental concepts reviewed include probability theory, error distribution, propagation errors, and the least squares method. The emphasis is to aid the scientist in obtaining an estimation of the error in observing physical quantities. N.E.N.

N68-12301# New Mexico State Univ., University Park. Research Center.
THERMAL LIGHT SCATTERING BY IONIC CRYSTALS Final Technical Report
Melvin D. Daybell, Otto H. Theimer, and Kenneth O. White (Ph.D. Thesis) Aug. 1967 148 p refs
(Contract Nonr-3531(02))
(AD-661247)

The temperature and crystal orientation dependence of the thermal scattering by ionic crystals is studied in the temperature range 78 to 300 degrees Kelvin, with the following results. The absolute magnitude of the intensity, the temperature dependence in first approximation, and the shift in wavelength from the incident wavelength of the components of the ideal crystal Brillouin scattering all agree with theory. The defect scattering increases linearly with temperature in first approximation. The depolarization ratios rho sub V are approximately zero. The defect scattering as a function of the crystal orientation angle theta has 2-fold symmetry. These defect scattering results are explained in terms of clouds of

point-like scattering units (vacancies) around charged edge dislocations with the dislocations aligned approximately parallel to a single (100) direction in the crystal. The core of the dislocation, a region of great disorder, acts as a source and sink of vacancies and the change in the number density of the vacancies with temperature leads to the observed temperature dependence. The measurement of the scattered light as a function of the angle theta allows the intensity of the true, ideal crystal, Rayleigh scattering and the Landau-Placzek ratio for sodium chloride to be determined for the first time. The results are obtained with the essential help of a new detection technique which eliminates the stray background light without using the immersion technique or special crystal geometries. Author (TAB)

N68-12323*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PHYSICS
In its Space Programs Sum. No. 37-47, Vol. 3 31 Oct. 1967 p 198-211 refs (See N68-12306 03-30)

Studies are reported on the dipole moment of OH; a microwave spectrometer for the study of free radicals; Newtonian gravity theory in dyadic notation; and density waves in a self-gravitating stellar system with uniform rotation. A determination is made of the dipole moment for the OH radical which is about an order of magnitude better than earlier studies. In the second area it is reported that a special microwave absorption cell was constructed for the study of free radicals that are present in planetary atmospheres or in space. Evaluation of the cell's performance was accomplished by making precision measurements of the dipole moment of the OH free radical. In the gravity theory area the equations of classical Newtonian physics are written in dyadic notation, where observables are seen as local quantities in an arbitrarily moving reference frame. The last area considers a model system with homogeneous density and uniform rotation, and which possesses an anisotropic Schwarzschild distribution function. Results of this study invalidate previous results of studies proposing that density wave propagation is the essential mechanism responsible for the formation of galactic spirals. C.T.C.

N68-12353 Commissariat a l'Energie Atomique, Limeil (France).
SEMI-EMPIRICAL EQUATION OF STATE OF METALS [EQUATION D'ETAT SEMI-EMPIRIQUE DES METAUX]
Rene Gasnier 15 Sep. 1967 6 p refs In FRENCH Presented at High Dyn. Pressure, Paris, 11-15 Sep. 1967

The Mie-Gruneisen semiempirical equation of state is derived for solids, assuming that a metallic crystal can be represented by a system of simple harmonic oscillations. The equation of state is also evolved for liquid phases. Transl. by M.W.R.

N68-12381 Joint Publications Research Service, Washington, D. C.
THE FIELD OF A POINT RADIATOR IN A PLANE LAMINAR MEDIUM WITH RANDOM HETEROGENEITY
V. M. Komissarov 5 Dec. 1967 18 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Radiofiz. (Gor'kiy), v. 10, no. 4, 1967 p 498-508
(JPRS-43564) CFSTI: $3.00

The method of sequential approximations is used to calculate the field related with each of the rays arriving at the observation point for a point radiator placed in a plane laminar medium with random heterogeneity. The mean square fluctuation of phase and amplitude of the field and the function of mutual correlation is calculated in the case of arrival of only one ray at the observation point. The case of arrival of several rays is also analyzed. It is shown that fluctuations of the amplitude and phase of the resulting field are distributed normally. The second order moments characterizing the distribution of the fluctuations are calculated. Theory is illustrated by a numerical calculation for a particular form of dependence n(z). Author

N68-12417# Los Alamos Scientific Lab., N. Mex.
PULSED FIELD SKIN EFFECT CALCULATIONS FOR CYLINDRICAL CONDUCTORS
D. A. Baker, M. D. J. Mac Roberts 14 Sep. 1966 99 p
(Contract W-7405-ENG-36)
(LA-3500)

Calculations are described of pulsed magnetic field penetration into cylindrical conductors. A computer code was developed which calculates magnetic field penetration, surface electric field, and resistive damping in a capacitively driven RLC circuit including effects of a time varying skin depth. A set of dimensionless curves is given which allows one to estimate these factors. Generalizations of the method are discussed and an example is given. Author (NSA)

N68-12419# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INFRARED TECHNOLOGY IN SPACE
Yu. P. Safronov, Yu. G. Andrianov, and D. S. Iyevlev 2 May 1967 118 p refs Transl. into ENGLISH of the book "Infrakrasnaya Tekhnika v Kosmose" Moscow, Min. Oborony, 1963 p 1-135
(FTD-MT-65-46; AD-661047)

On 4 October, 1957, the Soviet people, with the launching of the first earth satellite, opened a new epoch in the history of human progress - the epoch of the storming of limitless cosmic space. In a short time our country achieved great successes in the interest of all peoples of our planet. There is reason to say that in the future the investigation of space will proceed at accelerating tempos. Mankind can enter the attack on space only by concentrating all knowledge and experience of the preceding development of society at a high level. Among other new types of technology in conquering space, an important role goes to infrared technology which, along with radio and radar engineering, can be used for observation and communication in space. Also, as considered abroad, it can be used to solve a number of military tasks, for example: for early detection of ballistic rockets, for guidance, and, in the future, for the destruction of military objects. The description of the use of infrared technology in space was written from the data of the domestic and foreign open press. The book is intended for the officer staff of our armed forces. Author (TAB)

N68-12480# California Inst. of Tech., Pasadena.
AFOSR PROGRAM ON LIQUID STRUCTURES Final Technical Report
C. J. Pings 31 Oct. 1967 13 p refs
(Contract AF 49(638)-1273)
(AFOSR-67-2512; AD-660884)

A brief summary is given of experimental and theoretical studies on forces and configurations at the molecular level in simple liquids. Particular attention was given to the critical region of fluids. The 35 publications resulting from the work are listed. TAB

N68-12515# Aerospace Corp., El Segundo, Calif.
A SOURCE OF CARBON RESONANCE RADIATION
A. Greenville Whittaker and P. Kintner Jul. 1967 24 p refs
(Contract F04695-67-C-0158)
(TR-0158(3250-40)-5; SAMSO-TR-67-19; AD-660894)

A hollow-cathode carbon resonance lamp was constructed, and the effect of anode configuration, filler gas (helium, argon, and neon), filler-gas pressure, and lamp current on the intensity of

emission lines in the region 1560 to 2000 A was studied. The carbon resonance triplet at 1657 A could be obtained with good intensity, as could the carbon line at 1931 A. The spectrum also showed a number of molecular bands, one of which interfered slightly with the carbon resonance line at 1657 A. The bands could be removed, however, by reducing the pressure of the filler gas. Author (TAB)

N68-12546# Brookhaven National Lab., Upton, N. Y.
SUPERCONDUCTING SYNCHROTRON MAGNETS
W. B. Sampson, R. B. Britton, G. H. Morgan, and P. F. Dahl [1966] 11 p refs Presented at 6th Intern. Conf. on High Energy Accelerators, Cambridge, Mass., 11–15 Sep. 1967 Sponsored by AEC
(BNL-11761; CONF-670930-3) CFSTI: HC $3.00/MF $0.65

The feasibility of using high-field pulsed superconducting magnets for proton synchrotrons is investigated. A study of the power losses resulting from pulsed operation of superconducting synchrotron-type magnets is presented. NSA

N68-12570# Sandia Corp., Albuquerque, N. Mex.
RELUCTANCE OF A TOROIDAL COIL WITH A RECTANGULAR CROSS-SECTIONAL AREA
P. R. Kalata Apr. 1967 6 p
(Contract AT(29-1)-789)
(SCL-TN-67-31)

A study of magnetic circuits emerged is described. The reluctance of a circuit is a function of the geometric configuration of the coil and the magnetic properties of the material. Assuming that the magnetic properties of a material are linear; i.e., μ is a constant, method calculate reluctance of a rectangular toroidal coil was sought. The following derivation may be of academic interest. The derivation and calculus used is straightforward. The derivative was found using the general form of reluctance and the equivalent value for parallel paths. It was then integrated to give a closed form for such a coil. A computer verification of this derivation has been developed and is presented. NSA

N68-12643# California Univ., Berkeley. Lawrence Radiation Lab.
PROGRAM FOR INVERSION OF SYSTEM ANALYSIS AND ITS APPLICATION TO THE DESIGN OF MAGNETS
Klaus Halbach Jul. 1967 32 p refs Presented at the 2nd Intern. Conf. on Magnet Technol., Oxford, 10–14 Jul. 1967
(Contract W-7405-ENG-48)
(UCRL-17436; CONF-670705-14) CFSTI: HC $3.00/MF $0.65

In recent years many computer programs have been developed that can be used to analyze the performance of specified systems. The design of a system can be interpreted as the task of finding a set of parameters that leads to a desired performance of that system. The PISA is a general purpose Program for Inversion of System Analysis that does this automatically in the following sense: Combined with the appropriate analysis program and given a starting configuration of a system, it varies a given set of parameters until a specified performance is obtained within close tolerances. For example, given the desired field configuration in the aperture of a strong-focusing magnet of given basic design such as an H magnet, the geometry of the pole face may be determined. The PISA has been coupled to several analysis programs and application of these packages to the design of magnets is discussed. It is also shown how this method can be used to find the adjustments of parameters that are necessary to obtain a desired performance of an existing piece of equipment. Author (NSA)

N68-12728# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
SPECTRUM STABILIZER [STABILISATEUR DE SPECTRES]
Guy Detoume May 1967 38 p refs In FRENCH
(CEA-R-3178)

A spectrum stabilizer is a control mechanism which renders an analytical chain reliable. It can detect a drift in the amplification and in the base of the energy scale, and can modify the characteristics of this chain. The results of a theoretical study make it possible to calculate the width and the abscissae of the peaks of a stabilized spectrum as a function of the drifts. The spectrostab is a numerical stabilizer of a continuous type; it provides the artificial reference peak at low energies. Experimental results give the performances obtained on a reference peak provided by a semiconductor detector, in the field of gamma spectroscopy. Author (NSA)

N68-12741*# Ball Bros. Research Corp., Boulder, Colo.
WOLF TRAP CONTINUATION STUDY Final Report
F. Burlingame and D. Buckendahl 5 Oct. 1967 62 p refs Prepared for Rochester Univ.
(Grant NsG-209-AG1)
(NASA-CR-91053; F67-13) CFSTI: HC $3.00/MF $0.65 CSCL 20F

The Wolf Trap device was designed to detect microbial life in space by providing information on light scattering and pH changes. Part of the development program was a critical evaluation to determine the conclusiveness of the data provided by the Wolf Trap. The present report reviews the theory of light scattering, X-ray scattering, conductivity, and fluorescence. Additionally discussed are the aspects which should be considered in future decisions on Wolf Trap. Alternative methods for measuring chemical changes caused by biological activity are briefly considered because of the present-day technological deficiencies that exist in pH probe manufacture. K.W.

N68-12761# Sandia Corp., Albuquerque, N. Mex.
PNEUMATICALLY EXCITED TUNING FORK
R. S. Sidell Sep. 1967 22 p
(Contract AT(29-1)-789)
(SC-TM-67-712) CFSTI: HC $3.00/MF $0.65

If a tuning fork is combined with a flapper nozzle valve, the plenum pressure in the flapper nozzle valve will fluctuate at a frequency near the undriven tuning fork frequency. The system is dynamically unstable, and the oscillation will persist. The system was analyzed and the effect of parameter variations determined. It is found that large variations in the pneumatic parameters have a negligible effect on the frequency. Author (NSA)

N68-12764# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
OPERATION OF A DIRECT CURRENT TRANSFORMER USED AS A "FLUX PUMP" [FONCTIONNEMENT DU TRANSFORMATEUR A COURANT CONTINU UTILISE EN "POMPE A FLUX"]
Jean-Louis Deschanels Jul. 1967 7 p In FRENCH
(CEA-R-3249)

Equations governing the operation of a flux pump with a superconducting transformer are derived. It shows that there exists a limiting value of the current in the charge coil and that the limit is independent of this coil. Author (NSA)

N68-12765 California Univ., Livermore. Lawrence Radiation Lab.
SHOCK-WAVE STUDIES IN CONDENSED MEDIA
R. E. Duff, W. H. Gust, E. B. Royce, A. C. Mitchell, R. N. Keeler et al 1967 15 p refs Presented at the Symp. on High Dyn. Pressure, Paris, 11–15 Sep. 1967

A brief survey is presented of several recent shock wave investigations of material properties at high pressures. A summary is given of some recently observed dynamic phase transitions in

metals and ionic crystals with implications in static high-pressure scale calibration. The applications of some of the principles of modern optics to shock wave experiments are outlined. Direct measurements of shock velocity, particle velocity, and sound speed in a shocked material are described and illustrated. Author

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N68-11927# RAND Corp., Santa Monica, Calif.
A REVIEW OF ATOMIC AND MOLECULAR EXCITATION MECHANISMS IN NONEQUILIBRIUM GASES UP TO 20,000°K
Forrest R. Gilmore, Ernest Bauer, and J. William McGowan Sep. 1967 56 p refs
(Contract DAHC15-67-C-0141; ARPA Order 189-1)
(RM-5202-ARPA; AD-661233)

The review summarizes present knowledge of the atomic and molecular mechanisms that produce or remove rotationally, vibrationally, and electronically excited species in heated or excited gases. A logical classification scheme for these mechanisms is introduced, and the extent of present information on each class is indicated. The validity and utility of several general rules and regularities are also examined. An appendix includes a table of rate coefficients for vibrational and electronic excitation and de-excitation reactions, taken directly from or derived from data in the literature. This table provides comprehensive coverage of some classes of reactions and representative coverage of the others.
Author (TAB)

N68-11964*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.
ALPHA PARTICLE ELASTIC SCATTERING
G. Payne [1966] 21 p refs
Grant NSG-233-62; Contract AT(11-1)-1190)
(NASA-CR-91118; Rept.-67-55) CSCL 20H

The elastic scattering of alpha particles by alpha particles is calculated from threshold to 100 MeV laboratory energy using both the Schroedinger equation and the N/D equations. The N/D equations do not yield very accurate results. The Schroedinger equation solution extends an earlier calculation of Preist to higher energies, higher partial waves, and uses more recent values of meson nucleon coupling constants. With slight changes in their values we obtain good agreement with experimental phase shifts to 100 MeV for $l=0, 2, 4$. Author

N68-11985# Aktiebolaget Atomenergi, Studsvik (Sweden).
ATOMIC MOTION IN LIQUID ARGON
K. Skold and K. E. Larsson 28 Nov. 1966 46 p refs Conf. of the Swedish Natl. Comm. for Phys. held in Uppsala
(FFN-60; CONF-65076-2)

The atomic motion in liquid argon at 94°K was investigated by inelastic scattering of 4.1 Å neutrons. Special attention was paid to the collective aspects of the motion and the observations were therefore confined to momentum transfers in the region $1.3 < \kappa < 3.3$ Å^{-1} which includes the main peak of the liquid structure factor. The results are compared to various models. These comparisons give strong evidence of collective modes and an extreme polycrystalline model, in which even the polarization of the phonons is retained, gives the best description of the data. There is also definite evidence of a second Brillouin zone in liquid argon. A dispersion relation with a slope close to the measured velocity of sound and in good agreement with earlier neutron results is obtained. The frequency spectrum was determined and compared to the results of a computer calculation by Rahman. Author (NSA)

N68-11994# Atomic Energy Centre, Dacca (Pakistan).
BOUND STATE EIGENVALUE PROGRAMME FOR REAL POTENTIALS
Shamsher Ali and Mazharul Islam Sep. 1966 12 p refs
(AECD-TP-16)

A program is proposed to seek solutions for the radial Schroedinger equation of a bound system of two particles for real and central potentials. The program given provides various quantities of interest for such a system. Included in these quantities are binding energy, wave functions at various distances, root-mean square separation, and expectation values of the kinetic and potential energies. NSA

N68-11997# European Organization for Nuclear Research, Geneva (Switzerland).
EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH Annual Report, 1966
[1967] 169 p refs
(AR-12; NP-16811)

The research activities of the various divisions of CERN during 1966 are presented. The divisions are nuclear physics, synchrocyclotron, track chambers, theoretical physics, proton synchrotron, nuclear physics apparatus, data handling, intersecting storage ring, accelerator research, finance, personnel, technical services and buildings division, health physics, general safety, and central services. NSA

N68-12006# Utah State Univ., Logan. Electro-Dynamics Labs.
NON-EQUILIBRIUM SOLUTIONS FOR THE RADIATIVE DECAY OF A SYSTEM OF OSCILLATORS, HARMONIC AND ANHARMONIC
Carl F. Zitlau and William M. Moore 1 Aug. 1967 133 p refs
(Contract AF 19(628)-5916)
(SR-2; AFCRL-67-0496; AD-660908)

The non-equilibrium vibrational energy distribution function was derived for a low pressure model in which the oscillators can exchange vibrational energy, radiate their energy irreversibly, and be irreversibly destroyed by some constant process. Initial Boltzmann and delta-function distribution using the Landau-Teller harmonic oscillator transition probabilities give solutions that are not of the Boltzmann form with a time dependent temperature. However this solution under conditions such that collisional vibrational exchange is much faster than the radiations is Boltzmann as well as the solution for the other extreme in which there are no interactions if the initial distribution is Boltzmann. Also the effect of nonlinear first overtone radiative transitions is investigated under time-dependent Boltzmann equilibrium conditions and found to be negligible for a typical molecule such as carbon monoxide. Author (TAB)

N68-12065*# Volt Technical Corp., Washington, D. C.
CASE OF GENERATION OF HEAVY NUCLEI IN THE SUN [SLUCHAY GENERATSII TYAZHELYKH YADER NA SOLNTSE]
A. A. Suslov and I. P. Tindo 30 Oct. 1967 8 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 5, no. 4, 1967 p 617–621
(Contract NAS5-12487)
(NASA-CR-91043; ST-CR-SP-10661) CFSTI: $3.00 CSCL 20H

A case is described of flux increase of heavy nuclei ($Z \geq 15$) in the composition of cosmic rays registered on 23–24 February

1964 on Elektron-2 simultaneously with the detection by the Geiger counters of the same AES of bursts of Sun's X-ray radiation. During the period no notable flux increase of nuclei with $Z \geq 2$, $Z \geq 5$ and of the proton component was observed. The possibility of random coincidence in the increases of nuclei fluxes and X-ray bursts is evaluated. It was found to be 1.5×10^{-5}. This leads to the assumption about a case of generation of nuclei in the Sun, with the escape beyond the limits of solar atmosphere of mostly heavy nuclei and of X-ray bremmstrahlung of electrons. Author

N68-12068*# Volt Technical Corp., Washington, D. C.
MULTIPARTICLE INTERACTIONS IN THE HIGH- AND SUPERHIGH-ENERGY REGION
I. Z. Artykov, V. S. Barashenkov, and S. M. Eliseyev 30 Nov. 1967 5 p refs Transl. into ENGLISH from Russian
(Contract NAS5-12487)
(NASA-CR-91039; ST-PF-NP-10662) CFSTI: HC $3.00/MF $0.65
CSCL 20H

Experimental and theoretical data on nuclear interactions for energies T>30 Gev were correlated for each fixed T-value within a broad range of assumptions concerning the properties of multiparticle interactions. Theoretical data involved step-by-step Monte Carlo calculations. Graphic data (obtained through use of a digital computer) depicting the unstandardized energetic and angular distributions of particles from inelastic multiparticle interactions for several energy values, are presented. Although no significance can be attributed to the details of the distributions, their main features are invariable. L.S.

N68-12099# Providence Coll., R. I. Dept. of Physics.
RESEARCH DIRECTED TOWARDS THE STUDY OF FAR INFRARED ABSORPTION CONTOURS Final Report, Feb. 1, 1962-Jan. 31, 1967
Edwin K. Gora Jul. 1967 51 p refs
(Contract AF 19(628)-282)
(AFCRL-67-0482; AD-660610)

Research was directed towards the formulation and extension of mathematical and theoretical methods suitable to calculate frequencies, intensities, and shapes of far-infrared lines, in particular, of asymmetric rotor molecules. A previously formulated asymptotic method applicable to high J-low K asymmetric rotor levels was extended to angular momentum expectation values of higher order. A minimization procedure previously used in the theory of diatomic molecules was adapted to nonlinear triatomic molecules, and employed to derive formulas for centrifugal distorsion corrections of higher order in the angular momentum operators. A semi-classical treatment of vibrational anharmonic perturbations was formulated to supplement the minimization procedure. The development of these methods and procedures had been motivated by an analysis of SO2-absorption contours—line shape studies led to a phenomenological treatment describing simultaneously the transition from interruption to statistical broadening, and from Van Vleck-Weisskopf to Lorentzian broadening. Consideration of the duration of collisions proved essential in this formulation. Author (TAB)

N68-12106 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
EFFECT OF THE ONE-PHONON ADMIXTURES ON THE M1 AND E2 TRANSITION RATES IN ^{126}I AND ^{127}I [WPLYW DOMIESZEK JEDNO-FONONOWYCH NA PRAWDOPODOBIENSTWA PRZESC M1 I E2 W ^{126}I I ^{127}I]
J. Kownacki, J. Ludziejewski, and M. Moszynski 1967 25 p refs
(INR-812/IA/PL) CFSTI: $3.00

The half-lives of the excited states in I^{125} and I^{127} were measured with a time-to-amplitude converter. Based on the measurements, reduced transition probabilities B/M1/ and B/E2/ were established and the results compared with the predictions of the single particle model as well as with the pairing-plus-quadruple force model used by Kisslinger and Sorensen for spherical nuclei. Author

N68-12107 India. Dept. of Atomic Energy, Bombay.
FIELD THEORY TECHNIQUE AS APPLIED TO ELECTRONS IN EXTERNAL FIELD
P. G. Khubchandani and C. Manohar 1967 60 p refs
(BARC-292) CFSTI: $3.00

The discussion presents the field theory technique applied to fermions in an external field and shows its advantages by simple examples such as the summation of diagrams and the derivation of linked cluster expansion. The problem of non-interacting electrons in an external field was chosen to illustrate the technique. The problem is of interest from the viewpoint of theories of electrical conductivity in solids where the interaction between electrons is not as important as that of electrons with ions and impurities. The problem is also of interest in connection with screening of impurities, and is treated after the inclusion of electron–electron interactions. The treatment begins with the Hamiltonian in terms of the wave field operators and proceeds as in field theory to annihilation and creation operators, treating the many body problem as though it were a highly excited field. R.N.A.

N68-12163# Stanford Univ., Calif. Linear Accelerator Center.
ELECTRON SCATTERING BY POLARIZED HADRON TARGETS [RASSEYANIE ELEKTRONOV NA POLYARIZOVANNYKH ADRONNYKH MISHENYAKH]
V. M. Dubovik and A. A. Cheshkov 1966 19 p refs Transl. into ENGLISH from Joint Inst. for Nucl. Res. Rept. JINR-P2-2991
(SLAC-TRANS-65)

The cross section for electron–hadron scattering $e+N \rightarrow e+N'$ is calculated in the one-photon approximation. It is supposed that the target particle N has spin j and mass κ and a newly produced particle N'-spin j and mass κ'. All transition electromagnetic form factors are taken into account. The spin state of target particles is considered to be arbitrary and expressed in terms of the density matrix in the form of an expansion in irreducible spherical tensors. The selection rules of form factors are given under P- and T-invariance requirements. The contribution of T-noninvariant form factors to the cross section is discussed. Some important particular cases are obtained from the general cross section formula. Author (NSA)

N68-12170# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).
GAMMA-RAY SPECTRA FROM THE RADIATIVE CAPTURE OF 14 MEV NEUTRONS BY ^{28}SI AND ^{40}CA
F. Cvelbar, A. Hudoklin, and M. V. Mihailovic Jul. 1967 9 p refs
(NIJS-R-505) CFSTI: HC $3.00/MF $0.65

The spectra of gamma rays from the radiative capture of 14.1 MeV neutrons by ^{28}Si and ^{40}Ca measured by a telescopic scintillation pair spectrometer are presented. The spectrum for ^{28}Si is found to be similar to that of ^{27}Al. This fact supports a previous statement that the spectra for nuclei having the same configuration of neutrons exhibit a similar structure due to the preferred transitions to the single particle neutron states. The spectrum of gamma rays from the neutron capture by ^{40}Ca is fairly flat and has a rather well pronounced low energy limit due to the absence of gamma-rays from the $(n,n'\gamma)$ processes at gamma-ray energies higher than 11 MeV. Author

N68-12181# Aerospace Corp., El Segundo, Calif. Space Physics Lab.
PHOTOIONIZATION OF ELECTRONICALLY EXCITED OXYGEN: RATE OF THE REACTION: $O_2(A^1\delta_g)+O3 \rightarrow 2O_2+O$

Robert J. McNeal and Gilbert R. Cook Jun. 1967 20 p refs
(Contract AF 04(695)-1001)
(TR-1001(2260-10)-2; SSD-TR-67-158; AD-660898)

The photoionization spectrum of discharged oxygen was obtained in the wavelength region 1040-1240A with an argon continuum light source and a 1-m Seya-Namioka scanning vacuum-ultraviolet monochromator in a discharge-flow experiment. Photoionization was detected only at wavelengths shorter than or equal to 1118.0A. The observed ion current is due to photoionization of metastable O2(a(1)Delta-g), and the effects on the ion current of adding O2, N2, and O3 to the flow stream after the discharge are reported. O2 and N2 do not reduce the photoionization current except by small percentages attributable to dilution effects, and with added O2, to a slight absorption of the incident light flux. O3, however, sharply reduces the ion current and is partially decomposed by the discharged gas. These effects are attributed to the reaction O2(a(1)Delta-g) + O3 to 2O2(X(3)Sigma-g(-)) + O((3)P). Measurements of the reduction in photoionization current as a function of added O3 pressure and reaction time were made, and the rate coefficient for this reaction at room temperature was found to be (2-3) x 10 to the -15th power cu. cm/molecule/sec. This is a lower value than has been estimated from discharge-flow experiments in which the metastable species responsible for ozone decomposition could not be identified. Possible reasons for the discrepancy are discussed. Author (TAB)

N68-12183# Royal Aircraft Establishment, Farnborough (England).
SPONTANEOUS IGNITION OF KEROSENE (AVTUR) VAPOUR: THE EFFECT OF THE RATIO, VESSEL SURFACE AREA TO VOLUME
R. G. White May 1967 40 p refs
(RAE-TR-67107; AD-661182)

The minimum spontaneous ignition temperature of kerosene vapour in an 18 in diameter stainless steel sphere is shown to be raised by the insertion of additional metal surfaces into the vessel. On the basis of the ratio, surface area/volume, the results correlate well with minimum spontaneous ignition temperatures measured in empty vessels varying in diameter from 18 in to 1 in. It appears that metal inserts could be designed for installation in aircraft high temperature enclosures, including the fuel tanks of supersonic aircraft. By such means, reduction of ignition hazards should be realised. Author (TAB)

N68-12196# California Univ., Livermore. Lawrence Radiation Lab.
EXPERIMENTAL INVESTIGATION OF PARTICULAR FINAL-STATE DECAY MODES FOLLOWING PHOTO-PARTICLE REACTIONS IN O^{16}
John Thomas Caldwell (Ph.D. Thesis) 23 May 1967 117 p refs
(Contract W-7405-ENG-48)
(UCRL-50287) CFSTI: HC $3.00/MF $0.65

Two independent experiments investigating particular final-state decay modes following photo-particle reactions in ^{16}O were carried out with monoenergetic photons over the giant resonance region of 17 to 29 MeV. In the first experiment, a 4π neutron detector-spectrometer was used to obtain information on ground-state and excited-state transitions in the $^{16}O(\gamma,n)$ reaction. In the second experiment, de-excitation γ rays following $^{16}O(\gamma,n\gamma')$; $\gamma,p\gamma'$; and $\gamma,\alpha\gamma')$ reactions were detected. By combining the results of the two experiments, a total of twelve individual decay-mode cross sections were determined, including three sets of $^{15}O-^{15}N$ mirror-level decays and the $^{16}O(\gamma,\alpha\gamma')^{12}C$ (15.1-MeV final state) reaction. Seven of these decay modes had not been observed previously, and none had been investigated with monochromatic photons. By summing up all of the ^{16}O decay cross sections determined in this experiment and adding in the $^{16}O(\gamma,p)^{15}N$ ground-state cross section, a total absorption cross section was determined that agrees well with direct total absorption measurements. Author (NSA)

N68-12199# Aerospace Corp., El Segundo, Calif. Space Physics Lab.
EXPERIMENTAL VALUES OF THE ATOMIC ABSORPTION CROSS SECTION OF POTASSIUM BETWEEN 580 Å AND 1000 Å, MARCH–OCTOBER 1966
Robert D. Hudson and Virginia L. Carter Jun. 1967 21 p refs
(Contract AF 04(695)-1001)
(TR-1001(9260-01)-9; SSD-TR-67-155; AD-660898)

The atomic absorption cross section of potassium was measured between 580 and 1000A. The region between 685 and 1000A showed continuous absorption, and the values around 1000A were consistent with those obtained previously. In the region between 580 and 685A several autoionization lines were observed, in particular two strong lines corresponding to the (3p)(6) 4s to (3p)(5)(4s)(2)(2)P3/2, 1/2 transitions. This spectral region was studied photoelectrically at a bandwidth of 0.37A and photographically at 0.075A. Curves and tables are presented of the atomic absorption cross sections of potassium versus energy from the series limit to 580A, and a comparison is made between these results and recent theoretical estimates. An attempt was made to fit Fano-Beutler profiles to the measured line shapes of the (3p)(6) rs to (3p)(5)(4s)(2)(2)P3/2, 1/2 transitions, and the resulting line shape parameters are given. The sum of the oscillator strengths of these transitions was found to be 0.147. Author (TAB)

N68-12204# Los Alamos Scientific Corp., N. Mex.
OPTIMUM GEOMETRIES AND FIELD STRENGTHS FOR ALVAREZ LINACS
Donald A. Swenson 20 Jan. 1967 20 p refs
(Contract W-7405-ENG-36)
(LA-3567) CFSTI: HC $3.00/MF $0.65

A procedure is described for selecting the geometries and field strengths for an Alvarez linac which will produce a linac of a given performance for the least cost. The geometries are restricted to cylindrical cavities, loaded with cylindrical drift tubes having a cylindrical hole for passage of beam, and rounded corners (outer corner and hole corner) to reduce the high electric fields that would otherwise appear on the sharp corner. Several thousand cavities of this type have been evaluated with the linac field computational program, MESSYMESH. It is possible to display data from hundreds of MESSYMESH computations on a pair of graphs in such a way as to facilitate the evaluation of the economics. The data on these graphs are independent of the various cost coefficients which enter into the cost formula and are subject to change. Given these cost coefficients, it is a simple matter to select the optimum field strength and the optimum geometry. Author (NSA)

N68-12245*# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
ETC: A FORTRAN IV PROGRAM FOR COMPUTING THE MULTIGROUP P(0) AND P(1) ELASTIC TRANSFER COEFFICIENTS
Gordon Gibson and Marian Miller Feb. 1967 104 p refs
(Contract SNP-1)
(NASA-CR-91134; WANL-TME-1577) CFSTI: HC $3.00/MF $0.65 CSCL 18K

A description is given of the ETC program, written in FORTRAN FORTRAN IV, for calculating flux-averaged elements of the multigroup P(0) and P(1) transfer matrices. The same quantities are calculated with ETC as are calculated with the DOODLES program, and also with other programs. However, in deriving the equations for ETC, rather than carrying out a double integration numerically one of the integrations was carried out analytically. Therefore, the numerical integration need only be carried out over one variable, which results in a more satisfactory numerical treatment and faster calculation. NSA

N68-12270 Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics.

TOTAL REACTION CROSS-SECTION AND ELASTIC SCATTERING OF 24.7 MEV ALPHA PARTICLES IN THE REGION OF A=60 NUCLEI [CALKOWITE PRZEKROJE CZYNNE REAKCJI I ROZPRASZANIE ELASTYCZNE CZASTEK ALFA O ENERGII 24.7 MEV NA JADRACH W OBSZARZE A=60]

A. Budzanowski, K. Grotowski, J. Kuzminski, H. Niewodniczanski, A. Strzalkowski et al Jul. 1967 31 p refs

(INP-558/PL)

The total reaction cross sections for the interaction of alpha particles of the energy of 24.7 MeV with Cr, Fe, Ni, Co, Cu, and Zn nuclei were measured by means of the transmission method. The corrections to the transmission measurements for the elastic scattering and for the charged products of reactions were determined from a specially performed experiment. The results for the total reaction cross sections are in agreement with the optical model calculations. No minimum in the σ_R versus A curve for the nickel atomic mass numbers is observed. Author

N68-12279# Siemens-Schuckertwerke A. G., Erlangen (West Germany). Forschungslaboratorium.

RADIATION DAMAGE OF HALF-LIFE STRUCTURAL ELEMENTS THROUGH ELECTRON AND PROTON RADIATION [STRAHLENSCHAEDIGUNG VON HALBEITERBAUELEMENTEN DURCH ELEKTRONEN- UND PROTONENSTRAHLUNG]

R. Basuerlein and K. Wohlleben [1967] 33 p refs In GERMAN Presented at WGLR/DGRR Ann. Meeting, Karlsruhe, West Germany, Oct. 1967 Supported in part by Bundesmin. fur Wiss. Forsch.

(Rept.-67) CFSTI: HC $3.00/MF $0.65

Electron and proton damage effects in photovoltaic solar energy converter cells and silicon transistors exposed to corpuscular radiation are evaluated theoretically and experimentally. The formation of recombination centers for the minority carriers in solar energy cells decreased their life time and diffusion effects thus enhancing the inverse current of the diode. Irradiation of silicon transistors also reduced current output; this is attributed to lattice vacancies and the formation of ionized lattice atoms in isolation and boundary layers. A silicon oxide layer has some effect on the ionization damage in transistors, and the use of silicon nitride for field effect transistors markedly improves their resistance to solar radiation. Transl. by G.G.

N68-12282# Aerospace Corp., El Segundo, Calif.

PHOTOIONIZATION AND ABSORPTION COEFFICIENTS OF N_2O

G. R. Cook, P. H. Metzger, and M. Ogawa Jul. 1967 31 p refs

(Contract F04695-67-C-0158)

(TR-0158(9260-01)-3; SAMSO-TR-67-42; AD-660895)

Absolute photoionization and absorption coefficients of N2O gas have been measured in the 600 to 1000A region with a 1-m Seya-Namioka type scanning vacuum ultraviolet monochromator. The Hopfield helium continuum was used as a background source with photoelectric detection of the dispersed light. A number of peaks were observed in both the absorption and photoionization spectra at wavelengths that agreed well with those of a higher resolution photographic spectrum. The total continuum underlying the band structure has been estimated, as well as that fraction due to ionization and to dissociation. Fluorescence was observed when the wavelength of the incident light was shorter than 980A. A region of weak emission with a broad maximum at about 860A was followed by a strong fluorescent edge at 756A. Fine structure superimposed on the weak emission was attributed to predissociation. Preionization was observed in Rydberg states and, for the first time, also in the dissociation continuum. Differences in the interaction of the ionization continuum with states and continua are discussed. Author (TAB)

N68-12329# Oak Ridge National Lab., Tenn.

TABLE OF THE RATIO B_o/B_{max} FOR MAGNET COILS WITH RECTANGULAR CROSS SECTION AND UNIFORM CURRENT DENSITY

M. W. Garrett Aug. 1966 11 p refs

(Contract W-7405-ENG-26)

(ORNL-3972)

A table with over 4000 entries for the field ratios $K=B_{max}/B_o$ for the magnet coil parameters α, β, is presented. The table offers greater convenience and precision than a graphical presentation. Over a wider range, α may vary from 1.02 to 10, and β from 0.05 to 10. The table permits linear interpolation to one part in 1,000 or better. Several subroutines from a previously described zonal harmonic computer package were used in computing the table. L.S.

N68-12332# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).

PROMPT NUBAR MEASUREMENTS FOR THERMAL NEUTRON FISSION

J. W. Boldeman and A. W. Dalton Mar. 1967 40 p refs

(AAEC/E-172)

The number of prompt neutrons ($\bar{\nu}$) produced in the thermal neutron-induced fission of ^{233}U, ^{235}U, ^{239}Pu, and ^{241}Pu was determined with high accuracy using the liquid scintillator technique. Measurements were made relative to an assumed value of $\bar{\nu}=3.784$ for the spontaneous fission of ^{252}Cf. The present results are compared with previous measurements. Author (NSA)

N68-12348# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

ON THE CONSTRUCTION OF AN AXIOMATIC THEORY OF NONRENORMALIZED INTERACTIONS. 2: THE EXISTENCE OF THE SCATTERING MATRIX [K POSTROENIYU AKSIOMATICHESKOI TEORII NEPERENORMIRUEMYKH VZAIMODEISTVII. 2. SUSHCHESTVOVANIE MATRITSY RASSEYANIYA]

S. S. Khoruzhii 1966 16 p refs In RUSSIAN

(JINR-P02-3088)

In the framework of the Wightman approach in the theory of nonrenormalized interactions a strong asymptotic Haag–Ruel condition and the existence of the scattering matrix are proved. Author (NSA)

N68-12373 Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics.

SUM RULES FOR INELASTIC ELECTRON SCATTERING [REGULY SUM DLA NIEELASTYCZNEGO ROZPRASZANIA ELEKTRONOW NA JADRACH ATOMOWYCH]

W. Czyz Aug. 1967 30 p refs Presented at the MIT LINAC Study Group, 1967

(INP-566/PL)

Various sum rules for inelastic electron scattering from nuclei are discussed together with some applications. Author

N68-12386# Western Reserve Univ., Cleveland, Ohio. Dept. of Physics.

SYSTEMATICS OF MUON CAPTURE IN A NUCLEAR SHELL MODEL

Alexander Bogan, Jr. (Ph.D. Thesis—Case Inst. of Tech.) Jun. 1967 148 p refs

(Contract AT(11-1)-1573)

(COO-1573-13) CFSTI: $3.00/MF $0.65

The implications of the universal Fermi interaction (UFI) hypothesis with bare V–A coupling and conserved vector current to the total rate for muon capture in nuclei are reviewed. The total capture rates for many nuclei are calculated in a closure approximation using a nuclear shell model. It is found that restricting

the model to stable nuclei greatly reduces the scatter about a straight line on a Primakoff plot. The values predicted for the weak interaction coupling constants assuming reasonable values for the average momentum of the emitted neutrons are about two-thirds of the UFI values or, if one accepts the UFI coupling constants, the necessary neutrino momentum is found to be about 10% less than one would expect. The sources of error in this model are discussed, and it is concluded that the inability to accurately predict the total capture rate stems from the difficulty in choosing an appropriate average neutrino momentum as required by the closure approximation. Author (NSA)

N68-12387# Polish Academy of Sciences, Cracow. Inst. of Nuclear Research.

ELASTIC ELECTRON SCATTERING FROM NUCLEI AND NUCLEON–NUCLEON CORRELATIONS [ELASTYCZNE ROZPRASZANIE ELEKTRONOW NA JADRACH ATOMONYCH I KORELACJE MIEDZYNUKLEONOWE]

W. Czyz and L. Lesniak Apr. 1967 9 p refs

(INR-540/PL)

Arguments that elastic electron scattering from nuclei at large momentum transfers is very sensitive to the dynamical short range nucleon–nucleon correlations are given. Author (NSA)

N68-12388# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.

ON A MECHANISM OF THE FORMATION OF A MESIC DEUTERIUM MOLECULAR ION [OB ODNOM MEKHANIZME OBRAZOVANIYA MOLEKULYARNOGO IONA MO MEZODEITERIYA]

E. A. Vesman 1967 18 p refs In RUSSIAN

(JINR-P4-3256)

It is assumed that the mesic molecular ion $(dd\mu)^+$ has an excited vibrational level $\nu=1$ with the momentum $K=1$. The initial muonic atoms, $d\mu$, are considered to have distribution (3.1). The mechanism of the formation of the $(dd\mu)^+$ by electric dipole transition is discussed. The binding energy of this level, E_d, is considered to excite the vibrational levels of the big molecule consisting of the ion $(dd\mu)^+$, a nucleus d, and electrons. The rate of the formation, w, is found to be dependent on the average kinetic energy, $\bar{E}$, of the initial atom $d\mu$ with the maximum at the point $\bar{E}=E$. The process of the $(dd\mu)^+$ formation is considered to be rapid compared with the period of the nuclear vibrations in a big molecule. The dependence of the rate, w, on average kinetic energy of the initial atoms, $d\mu$ is compared with experimental values. This assumption and the experimental values suggest the binding energy of $(dd\mu)^+$ in the discussed state $|E_d| \approx (1.5-2)$ eV. Author (NSA)

N68-12392# Oak Ridge National Lab., Tenn.

A FORTRAN 4 PROGRAM FOR CALCULATING GENERAL TENSOR MOMENTS OF POLARIZATION IN NUCLEAR REACTIONS AND SCATTERINGS

R. D. McCulloch, H. W. Graben, S. T. Thornton, and H. B. Willard Jul. 1967 96 p refs

(Contract W-7405-ENG-26)

(ORNL-4125) CFSTI: HC $3.00/MF $0.65

A computer program for calculating the most general tensor moments of polarization was developed. Tensor moments of outgoing particles from a two-body final state reaction are calculated explicitly in terms of the tensor moments of the initial state particles, the scattering or reaction matrices, and the energy and angles. The computer program is organized into two parts. The first part computes the generalized tensor moments of polarization for the outgoing particles in terms of the tensor moments of the incoming particles, the reaction matrices, and the rotation matrices (D functions). In the second part the output of Part I can be rearranged according to J^π values; specific numerical values of the incoming tensor moments and particular values of the scattering angles, (θ,ϕ), defining the D functions can be input. The final output of the tensor moments depends only on the nuclear dynamics (or reaction matrices). Several options are available throughout the program. Author (NSA)

N68-12404# Lyon Univ. (France). Inst. de Physique Nucleaire.

DETERMINATION OF THE ENERGY AND BEAM STRUCTURE OF PARTICLES ACCELERATED BY THE 180-CM CYCLOTRON OF THE UNIVERSITY OF LYON [DETERMINATION DE L'ENERGIE ET DE LA STRUCTURE DU FAISCEAU DE PARTICULES ACCELEREES PAR LE SYNCHROCYCLOTRON DE 180 CM DE LA FACULTE DES SCIENCES DE LYON]

Samy Suraqui (Ph.D. Thesis) Feb. 1967 125 p refs In FRENCH

(LYCEN-6713)

Experimental devices were designed for determining the energy of a synchrocyclotron. The first device is a slowing down system and the second a thermoelectric probe. The principles, the development and the experimental results obtained with each are described. With the first device the energy of the accelerator could be determined statistically. It was established that the stability was very good for the operational conditions used, particularly in α. With the second device it was possible to make a tentative determination of the spatial structure of the beam. The possibilities for additional uses of each device are considered. NSA

N68-12408 India. Dept. of Atomic Energy, Bombay.

VAN DE GRAAFF LABORATORY PROGRESS REPORT

T. P. David, comp. 1967 53 p refs

(B.A.R.C.-291) CFSTI: $3.00

This report covers the operation and utilization of the 5.5 MeV Van de Graaff accelerator at Trombay during the year 1966, the fifth year of the accelerator operation. Experiments with charged particle reactions for the study of nuclear structure and nuclear reactions as well as angular correlation experiments have been continued. A number of research experiments have been carried out and are reported. A chart showing the machine availability for research experiments giving the time loss due to breakdowns during the 5 year period of its operation has been included. Author

N68-12414# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

JET ANALYSIS BY THE METHOD OF PRINCIPAL AXIS

Marian Danysz and Wojciech Wojcik 1967 17 p refs

(INR-807/VI/PH)

The analysis of six-prong jets at 8 GeV/c π^+ p interactions by the method of principal axis does not show the existence of well-separated bodies which could be identified as the known resonances. The shape of the jets does not show the significant flatness. Author (NSA)

N68-12430# California Univ., Berkeley. Lawrence Radiation Lab.

THE MEASUREMENT OF INTERNAL CONVERSION COEFFICIENTS UTILIZING SEMICONDUCTOR DETECTORS. DECAY SCHEME STUDIES OF THE ODD MASS GOLD ISOTOPES

Arthur Judd Haverfield (Ph.D. Thesis) 10 Nov. 1966 196 p refs

(Contract W-7405-ENG-48)

(UCRL-16969) CFSTI: HC $3.00/MF $0.65

The application of semiconductor detectors to measurements of internal conversion coefficients is extensively discussed, with particular emphasis being placed upon a spectrometer employing

both Si(Li) and Ge(Li) detectors for the simultaneous observation of conversion electrons and gamma rays. The construction, calibration, and use of such a spectrometer are described. Possible improvements in this system are also discussed. It is found that this type of spectrometer is best suited for ICC measurements of transitions following electron-capture decay, but many still be useful in cases of beta or positron decay. The level schemes of the odd-mass Au isotopes of mass 199, 197, 195, and 193 were examined from the decay of the respective odd-mass platinum and mercury isotopes. The measurement of numerous internal conversion coefficients permitted the assignment of spin and parity values to many of these levels. The systematic trends of many of the nuclear phenomena associated with these isotopes were examined as a function of neutron number. The experimental data were compared to the various theoretical approaches applicable to this region of nuclei. The internal conversion process is discussed along with the various experimental methods of ICC measurement. The calibration of semiconductor detectors for energy and intensity measurements is discussed. Extensive tables of standards for these calibration procedures are presented. Author (NSA)

N68-12432 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
BETA-RAY SCATTERING [ROZPRASZANIE PROMIENI BETA]
R. Szepke 1967 32 p refs In POLISH; ENGLISH summary
(Rept.-808/XV/J) CFSTI: $3.00

Angular distributions of back-scattered beta-rays against localization of radiation source, incidence angles, colimation of radiation beam, detector burden by radiation, and hardness of reflection material has been experimental investigated. An approach in comparison beta-reflection methods with a beta-transmission method for paper thickness gauging was carried out. Author

N68-12452# Hawaii Univ., Honolulu. Dept. of Physics and Astronomy.
HIGH ENERGY PHYSICS GROUP ANNUAL PROGRESS REPORT, DECEMBER 15, 1965–DECEMBER 15, 1966
Vincent Z. Peterson 11 Jan. 1967 50 p
(Contract AT(04-3)-511)
(UH-511-11) CFSTI: HC$3.00/MF$0.65

The bubble chamber program discussed includes preliminary results from 3.9-GeV/c π^-p film, bubble-density measurements, and the SLAC beam survey. The spark chamber program includes the $K_2^0 \rightarrow 2\pi^0$ experiment which is in progress, the K→4e experiment in preparation, polarization in the $\pi^- + p \rightarrow \pi^0 + n$; $\eta + n$, and $\pi^- + p \rightarrow \pi^0 + n$ and $\pi^- + p \rightarrow \eta^0 + n$ results. The theoretical work includes axiomatic quantum field theory, η^0 production, the baryon resonance model, octet dominance, SU(6) symmetry, quarks, π' (959) and δ (962) mass degeneracy, and meson (π)–nucleon phase shifts. NSA

N68-12481 Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics.
SCATTERING OF VERY HIGH ENERGY PARTICLES FROM NUCLEI AND NUCLEON–NUCLEON CORRELATIONS [ROZPRASZANIE CZASTEK BARDZO WYSOKICH ENERGII NA JADRACH ATOMOWYCH A KORELACJE NUKLEON–NUKLEON WJADRACH]
W. Czyz Aug. 1967 30 p refs Presented at MIT LINAC Study Group, 1967
(INP-587/PL/PH)

Three recent experiments with high energy electron and nucleon scattering from nuclei are analyzed. The experiments are: (1) the CERN experiment involving the scattering of ≈20 GeV protons from various light, medium, and heavy nuclei; (2) the Brookhaven experiment on the scattering of p = 1.7 GeV/c momentum protons from protons, deuterons, He 4, C 12, and O 16; and (3) the Stanford experiment dealing with the elastic scattering of electrons from He 4 with large momentum transfers. K.W.

N68-12482# Lyon Univ. (France). Inst. de Physique Nucleaire.
CONTRIBUTION TO THE IMPROVEMENT OF NUCLEAR MEASUREMENTS THROUGH DATA PROCESSING [CONTRIBUTION A L'AMELIORATION DES MESURES NUCLEAIRES PAR TRAITEMENT DE L'INFORMATION]
Bernard Escudie (Ph.D. Thesis) Mar. 1967 161 p refs In FRENCH
(LYCEN-6716)

A study was made of a device capable of separating the ideal constituents of interfering signals frequently found in nuclear spectrometry. The experimental data showed that the statistical fluctuations and the parasitic signals due to radioactive sources that could not be eliminated strongly perturbed the nuclear spectra observed. This lead to the suggestion of numerically filtering the perturbed signals or peaks by their adapted filters. The gain in precision is of the order of 10 or more. In the case of an identification experiment of particles by the ionization method, the detection of the presence and extraction by correlation was used. The filtering used made it possible to detect events with invariant performance as a function of the power of the background of the detecting junctions, which vary slowly with time. The statistical properties of the signals and the background make it possible to improve the signal-to-noise ratio by correlation. Author

N68-12485 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
ENERGY DISTRIBUTION OF LONG RANGE α-PARTICLES EMITTED DURING THE THERMAL NEUTRON FISSION OF ^{235}U [WIDMO ENERGETYCZNE DLUGOZASIEGOWYCH CZASTEK α EMITOWANYCH PODCZAS ROZSZCZEPIENIA ^{235}U NEUTRONAMI TERMICZNYMI]
M. Sowinski, J. Chwaszczewska, M. Dakowski, A. Gadomski, T. Krogulski et al 1967 15 p refs Submitted for publication
(Rept.-817/IA/PL)

The energy spectrum of the long range α particles emitted in the thermal neutron fission process of ^{235}U has been measured. A good fit has been found using the Gaussian distribution. The relative cross-section $/Yth/Y_{res}/$ for thermal and resonance neutrons was determined. An attempt to estimate the yields of the other charged particles emitted in the ternary fission was made. Author

N68-12487# Massachusetts Inst. of Tech., Cambridge. Fluid Mechanics Lab.
CALCULATION OF THREE-BODY IONIC RECOMBINATION RATE
Stephen A. Landon and James C. Keck Mar. 1967 34 p refs
(Contract Nonr-1841(93))
(Publ.-67-1; AD-660649)

The three-body ionic recombination rate at low densities is calculated for a slightly ionized gas by considering that the relaxation of the energy of molecules occurs by a diffusion process. The effective conductivity in the equivalent diffusion equation is the second moment of the energy transfer. The moments are derived in closed form using classical mechanics and enable the recombination rate constant to be obtained. The agreement of the results with experimental data is good and suggests that the diffusion approach is useful even where relatively large energy transfers are involved. Author (TAB)

N68-12489# Massachusetts Inst. of Tech., Cambridge. Fluid Mechanics Lab.
VIBRATIONAL RELAXATION OF ANHARMONIC OSCILLATOR MOLECULES

Kenneth N. C. Bray Jun. 1967 91 p refs
(Contract Nonr-1841(93))
(Publ.-67-3; AD-660651)

The vibrational relaxation of a system of anharmonic oscillator molecules was analysed, by a moment method. Exchange of vibrational energy between molecules was included, and plays an important part in the relaxation mechanism. Calculations for nitrogen show that, during vibrational excitation, the relaxation rate is only slightly different from that predicted by Landau and Teller, for harmonic oscillator molecules. However, very rapid vibrational de-excitation is found to occur, under conditions far from equilibrium. This is a result of a build-up of upper level vibrational populations, fed by rapid vibration-vibration exchanges. Author (TAB)

N68-12490# Brookhaven National Lab., Upton, N. Y.
EFFECTIVE TRANSVERSE PHASE SPACE DILUTION AND BEAM DENSITY DISTRIBUTION IN THE AGS
A. van Steenbergen [1967] 12 p refs Presented at the 6th Intern. Conf. on High Energy Accelerators, Cambridge, Mass., 11–15 Sep. 1967 Sponsored by AEC
(BNL-11765; CONF-670930-4) CFSTI: HC $3.00/MF $0.65

A study to investigate beam-intensity loss with the multiple-turn injection system of the Alternating-Gradient Synchrotron is presented. The emittance in the synchrotron is obtained by using the kicker unit of the fast external beam system and channeling the low-energy beam into a short extraction channel immediately following the fast kicker, and subsequently measuring the beam density distributions with a scanning-slit wire-target combination. The relation of emittance behavior to beam intensity, the effective phase space dilution, and the phase space density distribution are investigated. NSA

N68-12504# Los Alamos Scientific Lab., N. Mex.
REFERENCE SPECTROMETRIC ALPHA SOURCES
B. M. Aleksandrov, A. F. Belyatskii, I. B. Berkovich, E. A. Volkova, D. M. Ziv et al 1966 26 p refs Presented at IAEA Symp. on the Standardization of Radionuclides, Vienna, 10–14 Oct. 1966
(LA-TR-66-80; SM-79/75; CONF-661012-7) CFSTI: HC $3.00/MF $0.65

A method was developed for the fabrication of 21 different types of reference alpha sources with both one and a mixture of different isotopes and for determining the basic physical characteristics of spectrometric sources in which the following isotopes are used: ^{233}U, ^{239}Pu, ^{241}Am, ^{238}Pu, ^{244}Cm, ^{242}Cm, and ^{228}Th. These reference sources are designed for calibrating semiconductor alpha spectrometers and other spectrometric and counting apparatus. The alpha particles emitted by the source have a small energy scatter. The sources fall into three categories, depending on the "intrinsic half-width of the alpha lines": up to 10 keV, 10 to 20 keV, and 20 to 50 keV. Most of the sources fall into the first two categories. The energies of the alpha particles emitted by the reference sources were determined to within 2 to 5 keV. With the help of a precision magnetic alpha spectrometer, the shape of the alpha lines was investigated in the process of developing the method of manufacturing the source, and a constant check was kept on the energy shift of the alpha lines due to self-absorption and to energy losses from the film coating. Author (NSA)

N68-12510# Columbia Univ., Irvington, N. Y. Nevis Labs.
SEARCH FOR INTERMEDIATE BOSONS IN PROTON–NUCLEON COLLISIONS
R. Burns, E. Hyman, L. Lederman, W. Lee, J. Rettberg et al Jul. 1966 40 p refs
(Contract AT(30-1)-1932)
(NEVIS-153; R-555; CU-257) CFSTI: HC $3.00/MF $0.65

An experimental study was made of high energy muons ($\geq$10 BeV/c) emerging from 30-BeV proton–nucleon collisions as a function of emission angle. Pion and kaon contributions were suppressed by reducing the decay path to an absolute minimum. In this way, the relative sensitivity to short-lived muon sources is enhanced considerably. The residual contribution was studied experimentally. Finally, various models are investigated which would give rise to muons with large transverse momentum. The models are applied to intermediate vector boson production in order to study the sensitivity of the search to the presence of these or other massive states which can decay promtply into leptons. Author

N68-12517# California Univ., Berkeley. Lawrence Radiation Lab.
EXPERIMENTAL DETERMINATION OF THE K Σ N PARITY USING A POLARIZED TARGET
Byron D. Dieterle (Ph.D. Thesis) Dec. 1966 53 p refs
(Contract W-7405-ENG-48)
(UCRL-17230) CFSTI: HC $3.00/MF $0.65

The KΣN parity was determined using the reaction $\pi^+ p \rightarrow K^+ \Sigma^+$. A crystal containing polarized protons was used as the target. The counting rates for events produced from protons polarized parallel and antiparallel to P_Σ were compared, where P_Σ is the polarization of Σ's produced from unpolarized protons and was previously measured. A higher counting rate was obtained for events for which the protons were polarized parallel to P_Σ, which means that the production amplitude is a scalar. As a scalar amplitude connects states of the same parity, the KΣN parity was obtained: $I_{K\Sigma N} = I_{\pi p} = -1$. This result depends only on the assumptions of spin 1/2 for the sigma and parity conservation in the reaction. Error estimates give 80 percent probability that the result agrees with an assignment $I_{K\Sigma N} = -1$. The probability for agreement with $I_{K\Sigma N} = +1$ is 2%. The result agrees with the usual expectations (as from SU_3) and with a previous experimental determination. Author (NSA)

N68-12520# Columbia Univ., Irvington, N. Y. Nevis Lab.
ANNIHILATIONS OF ANTIPROTONS AT REST IN HYDROGEN. 6: KAONIC FINAL STATES
N. Barash, L. Kirsch, D. Miller, and T. H. Tan Sep. 1966 27 p refs
(Contract AT(30-1)-1932)
(NEVIS-154; R-561; CU-258) CFSTI: HC $3.00/MF $0.65

Experimental results on the annihilation of stopped antiprotons into $K\bar{K}+3\pi$, $K\bar{K}\eta$, and $K\bar{K}\omega$ are presented. The branching ratios for $\bar{p}+p \rightarrow K_1 K_1 \eta$ and $\bar{p}+p \rightarrow K_1 K_1 \omega$ are found to be $(0.25 \pm 0.04) \times 10^{-3}$ and $(1.08 \pm 0.16) \times 10^{-3}$, respectively. From events of the latter reaction the width of the ω meson is found to be 12.3±2.0 MeV. The E^0 meson is observed and evidence is seen for the assignment of even charge conjugation and even G parity to this resonance. In addition, events from the reaction $\bar{p}+p \rightarrow K_1 K^\pm \pi^\pm$ were used to measure the mass difference between the charged and neutral K^*. Author (NSA)

N68-12521# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
THE CHARGE FORM FACTOR OF THE PROTON AT A MOMENTUM TRANSFER OF 75 F^{-2}
W. Bartel, B. Dudelzak, H. Krehbiel, J. M. McElroy, U. Meyer-Berkhout et al May 1967 8p refs
(DESY-67/18)

Cross sections for elastic electron–proton scattering were measured at $q^2 = 75\ f^{-2}$ in order to distinguish between the proton charge form factor $G_E = 0$ and $G_E = G_{M/\mu}$ at this momentum transfer. The measurement was performed using the same apparatus as in a previous experiment. The experimental data were found to be consistent with the Rosenbluth formula within the limits of error. The proton charge form factor was found to be different from zero at $q^2 = 75\ f^{-2}$ and consistent with the scaling law $G_E = G_{M/\mu}$. NSA

N68-12528# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

REACTOR PHYSICS DEPARTMENT TECHNICAL ACTIVITIES Quarterly Report, Oct.–Dec. 1966

15 Apr. 1967 68 p refs

(Contract AT(45-1)-1830)

(BNWL-400) CFSTI: HC$3.00/MF$0.65

Thermalization theory integral formulation is presented; single particle wave functions describing low energy elastic scattering by target nuclei of He and O are described. A computer program, BROAD, for direct calculation of temperature dependent cross sections has been written. Modifications were made to UNICORN, HRG, TEMPTEST, ZODIAC 2, ZODIAC 3, and ZODIAC F. The computer code OP has been written for shielding studies. CONVRT has been written to convert foil activation data from paper tape to digital computer language. Reactivity coefficients are presented for a Pu fueled light water reactor. A description of the gamma facility used to acquire data from irradiated fuel elements is given. The development of the reactivity technique for determination of effective ^{10}B concentration in samples of borated D_2O is described. The results of critical experiments in the PRCF are given. Results from an extensive set of reactivity measurements of neutron absorbing rods in PuO_2–UO_2–H_2O lattices are summarized. The worth of the HTLTR control rods are given. Comparisons of unzoned and two-zoned concepts for the FTR are detailed. Crystalline binding effects on the FTR Doppler coefficient are discussed. FTR fuel heterogeneity effects are examined. Fast reactor investigations for the FTR are presented. Reactivity measurement techniques using pulsed neutrons are discussed. Analyses of critical experiments in hydrogenous media are given. Crystal spectrometer studies of atomic and molecular motions of water at 268°K and 299°K are presented. Cross section data for slow neutron inelastic scattering in H_2O and D_2O are presented. NSA

N68-12545# Paris Univ. (France). Laboratoire de Physique Theorique.

NUCLEI AS ELEMENTARY PARTICLES

Henry Primakoff [1966] 43 p

(NP-16795)

Previous work in which the weak interactions of nuclei are treated without any explicit consideration whatever of the nuclei as composed of nucleons is summarized. The weak interaction matrix elements between the initial and final nuclear states involved are described in terms of form factors characteristic of the nuclei as wholes. The numerical values of these form factors (at the relevant momentum transfers) reflect the complexity of the internal nuclear structure. Such a treatment is analogous to the customary treatment of weak and electromagnetic interactions of nucleons where nucleons are composed of quarks. Nuclear beta decay, nuclear muon capture, and sum rules in nuclear beta decay are covered. NSA

N68-12549# Rice Univ., Houston, Tex. Dept. of Physics.

EXCITATION OF N=4 AND N=5 STATES IN HE(2)

J. A. Jordan, Jr., R. E. Yager, and G. S. Bakken Jan. 1967 7 p refs Presented at the 5th Intern. Conf. on Phys. of Electron. and Atomic Collisions, Leningrad, 17–23 Jul. 1967

(Contract AT(40-1)-1316)

(ORO-1316-24; CONF-670702-4) CFSTI: HC$3.00/MF$0.65

A monoenergetic, high-velocity helium ion beam was used to determine excitation cross section in fast-ion collision processes. The beam passes through a thin carbon foil where some of the beam atoms are promoted to excited states, which decay with appreciable radiation downstream of the foil. A plot of the intensity of a given spectral line against the distance to the foil from the point of observation in the beam provides a well-resolved decay curve of the higher energy state. NSA

N68-12560# Colorado Univ., Boulder. Dept. of Physics and Astrophysics.

HIGH ENERGY PHYSICS Annual Progress Report, Jun. 1966–Jun. 1967

Leona Marshall Libby Jun. 1967 12 p refs

(Contract AT(11-1)-1537)

(COO-1537-1) CFSTI: HC$3.00/MF$0.65

The work in progress at the University of Colorado includes film measuring and computation. Several experiments now in progress are briefly described. These are $K^- + p$, $\pi^- + p$, $\bar{p} + p$, $K^- + d$ interactions, and world analysis of the lambda magnetic moment. Optical model computations, the application of a computerized dirac equation to elastic diffraction patterns for $\bar{p} + p$, $K^- + p$, and $\pi + p$ interactions, and the production of free radicals and radioactive species in planetary atmospheres by solar radiation and high particles in cosmic rays are also mentioned. NSA

N68-12560# Lyon Univ. (France). Inst. de Physique Nucleaire.

GRAPHICAL THEORY OF CLEBSCH–GORDAN COEFFICIENTS OF IRREDUCIBLE OPERATORS, AND ISOSCALAR FACTORS IN SU_3 [THEORIE GRAPHIQUE DES COEFFICIENTS DE CLEBSCH–GORDAN, DES OPERATEURS IRREDUCTIBLES ET DES FACTEURS ISOSCALAIRES DANS SU_3]

Boris Castel (Ph.D. Thesis) 7 Apr. 1967 96 p refs In FRENCH

(LYCEN-6727)

After a brief resume of the results of group theory applied to SU_3, the graphical formalism of the Clebsch–Gordan coefficient, irreducible tensors, and rotation matrices is developed. A brief demonstration is given of the Wigner–Eckart theorem. The graphic structure of the isoscalar factors are utilized to find results of particular cases. The possibility of the graphic method is illustrated by taking up the problem of the increasing matrix in high energy reactions. In particular it is shown that the graphic treatment, which makes it possible to best visualize the physics problem, gives excellent demonstrations of results not mathematically obtainable. Author (NSA)

N68-12561# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.

AN ATTEMPT OF DETERMINATION OF PROTON–NUCLEON ELASTIC CROSS SECTION IN TEV REGION

K. Rybicki 1967 5 p refs Submitted for publication

(INR-802/6/PH)

There were 5.82 m of ultra-high-energy-proton ($E > 1$ TeV) track line-scanned for stars resulting from elastic scatterings on nucleons bound in emulsion nuclei. Three events of this type were found. In order to find the probability of visible evaporation of the nucleus in such process, a similar scanning was performed on 24-GeV proton tracks. The proton–nucleon elastic cross section $\sigma_{el} = (3.8^{+12.7}_{-1.5})$ mb was obtained in the TeV region. Author (NSA)

N68-12572# Stanford Univ., Calif. Stanford Linear Accelerator Center.

HIGH ENERGY BEHAVIOR OF LOCAL QUANTUM FIELDS

Arthur M. Jaffe Dec. 1966 24 p refs Presented at Am. Phys. Soc., Stanford, Calif., 29 Dec. 1966

(Contract AT(04-3)-515)

(SLAC-PUB-250; CONF-661210-1) CFSTI: HC$3.00/MF$0.65

Quantum field theories having singular high-energy behavior are considered. The idea of a strictly localizable field is defined, and it is shown that it is possible to work out the general principles of field theory for any field which is localizable in that sense. These fields are considered on an equal basis with those usually studied. Also a useful high-energy bound is derived from strict localizability. NSA

N68-12579# Oak Ridge National Lab., Tenn.
SOME RECENT NUCLEAR CROSS SECTION MEASUREMENTS AT ORNL, APRIL 1, 1967–SEPTEMBER 30, 1967
P. H. Stelson Sep. 1967 18 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1991) CFSTI: HC $3.00/MF $0.65

Measurements were made of neutron elastic and inelastic differential cross sections on C, Mg, Al, Si, S, Fe, Co, and Y at 7.6 MeV. Also reported are total cross sections for neutron elastic and inelastic scattering by ^{56}Fe at 4.60 to 7.55 MeV and gamma-ray spectra from neutron inelastic scattering by ^{14}N at 6.0 to 8.4 MeV. NSA

N68-12583# Argonne National Lab., Ill.
LUMINESCENCE OF SOME MOLECULAR GASES FROM EXCITATION BY FAST ELECTRONS, 2
Horst Anton Jun. 1967 21 p refs Transl. into ENGLISH from Ann. Physik (Leipzig), no. 18, issue 7, 1966 p 178–193
(ANL-TRANS-491) CFSTI: HC $3.00/MF $0.65

Additional studies on the luminescence of molecular gases, (N_2, CO_2, O_2, air, and N_2–O_2 mixtures) following excitation with 50-keV electrons are reported. From spectroscopic observations and decay time measurements conclusions can be drawn on the most significant excitation and quenching mechanisms of the luminescence. Author (NSA)

N68-12589# Deutsche Akademie der Wissenschaften zu Rossendorf (East Germany).
PROCEEDINGS OF THE CONFERENCE ON NUCLEAR REACTIONS WITH LIGHT NUCLEI AND NUCLEAR STRUCTURE
Josef Schintlmeister, ed. Jul. 1966 364 p refs In GERMAN and ENGLISH Proc. of the Conf. held in Rossendorf (East Germany), 10–15 Jan. 1966
(ZFK-122; CONF-660118)

A collection of articles from a conference on nuclear reactions with light nuclei and nuclear structure is presented. Emphasis is placed on the fundamentals of nuclear physics research, and on single particle and collective states connected with medium mass number nuclei. C.T.C.

N68-12592# Joint Inst. for Nuclear Research, Dubna (USSR).
POLARIZATION EFFECTS BY INELASTIC ND SCATTERING. 3: QUASI-ELASTIC PP-SCATTERING [POLYARIZATSIONNYE EFFEKTY PRI NEUPRUGOM ND-RASSEYANII. 3: KVAZIUPRUGOE PP-RASSEYANIE]
B. M. Golovin and L. A. Kulyukina 1967 6 p refs In RUSSIAN
(JINR-P01-3215)

On the basis of the nonrelativistic impulse approximation, polarization parameters are calculated for the "normal total experiment" on quasi-pp scattering in N-d collisions. Author (NSA)

N68-12611# Amsterdam Univ. (Netherlands).
SOME NUCLEAR REACTIONS INDUCED BY D+T NEUTRONS
Walter Nagel (Ph.D. Thesis) 1966 87 p refs
(NP-16748)

A report is given on the study of some nuclear reactions induced by neutrons, produced by means of the reaction t(d,n)α, so called D+T neutrons. A general description is given of the reactions which are possible with high energy neutrons. Because of existing confusion in cross section terminology a section is inserted in which the definitions of terms used in this thesis are described. A historical survey of the development of work with D+T neutrons is presented. Methods by means of which cross sections can be determined are discussed. Results were obtained by the activation method and therefore the discussion is limited to methods which can produce results which are comparable with those presented. The production of D+T neutrons and reasons why the neutrons are not mono-energetic are discussed. The energy spread is discussed for the neutrons which are emitted by the two devices employed in the investigation. The methods available for the determination of the number of neutrons emitted are described. After a brief survey of the primary methods (α-counting and proton recoil counting) the consistency of these methods is discussed. The major part, however, is devoted to nuclear reactions which can be used as standards. The most likely shape of the excitation function is deduced for each of the reactions mainly used. With the published data on absolute cross sections, the absolute values were derived for these functions. NSA

N68-12612# Commissariat a l'Energie Atomique, Saclay (France).
CONTRIBUTION TO THE STUDY OF THE DESORPTION OF FISSION GASES FORMED IN IRRADIATED URANIUM OXIDE [CONTRIBUTION A L'ETUDE DE LA DESORPTION DES GAZ DE FISSION FORMES DANS L'OXYDE D'URANIUM IRRADIE]
Jean-Louis Berry, Raymond Darras, and Bernard Roger Sep. 1966 11 p In FRENCH
(CEA-R-3021)

The release of ^{133}Xe from irradiated UO_2 has been studied in the temperature range 1300 to 1900°C, using various monocrystalline or sintered samples. Up to 1600°C, this release is proportional to the square root of the time and thus occurs essentially by diffusion. The apparent diffusion constant D' decreases and the activation energy of the corresponding process increases as the integrated neutron flux received by the fuel increases. As the density of the sintered samples decreases however, the activation energy of the release also decreases, so that the difference between D' values for sintered samples of different densities decreases as the temperature rises. Finally, above 1600°C, the fission gas release phenomenon is governed by UO_2 evaporation, and all the different types of oxide studied have similar behaviors, characterized by poor retention of these gases. Author (NSA)

N68-12618# Rochester Univ., N. Y. Dept. of Chemistry.
NUCLEAR REACTION MECHANISMS Progress Report, 1 May 1966–1 May 1967
Marshall Blann 1 May 1967 169 refs
(Contract AT(30-1)-3591)
(UR-3591-5) CFSTI: HC $3.00/MF $0.65

Recoil ranges and excitation functions were measured for alpha-particle reactions with ^{90}Zr at 20 to 80 MeV, with ^{197}Au at 20 to 100 MeV, and ^{51}V at 5 to 120 MeV. The data were analyzed using the statistical theory with different level density models and different assumptions on the competition between γ-ray and nucleon emission. Recoil ranges for ^{55}Co, ^{56}Co, ^{57}Co, and ^{58}Co from deuteron-induced reactions on ^{58}Ni at 5.5 and 19.8 MeV were measured as were the angular distributions of Co recoil nuclei from alpha-particle reactions with ^{59}Co and ^{58}Ni at 62 MeV. Recoil ranges were used to test the "universal" range theory of Lindhard, Scharff, and Schiott. A chamber was developed for measuring heavy-ion energy losses in gaseous media, and a heavy ion source was developed for addition to a duoplasmatron proton source. NSA

N68-12620# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ON THE CONSTRUCTION OF AN AXIOMATIC THEORY OF NONRENORMALIZED INTERACTIONS. 1: NONRENORMALIZED FIELDS AS ANALYTICAL FUNCTIONALS [K POSTROENIYU AKSIOMATICHESKOI TEORII NEPERENORMIRUEMYE POLYA KAK ANALITICHESKIE FUNKTSIONALY]

S. S. Khoruzhii 1966 23 p refs In RUSSIAN
(JINR-P02-3085)

Formalism of the Wightman axiomatic approach is formulated for the case of nonrenormalized interactions. Various criteria of nonrenormalizability of the theory are investigated. A weakened locality condition, which is fulfilled in nonrenormalized theories, is found and analyzed. Author (NSA)

N68-12623# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics.
TO THE THEORY OF LINEAR INDUCTION ACCELERATOR [K TEORII LINEINOGO INDUKTSIONNOGO USKORITELYA]
I. M. Matora 1967 13 p refs In RUSSIAN
(JINR-P09-3184)

A differential equation, analogous to the Biot–Savart Law for calculation of an eddy electric field and a relativistic generalization of an equation for paraxial electron trajectories in a strong axially-symmetric electric field are given. Other formulas, necessary for calculation of a linear induction accelerator, are given. A possibility of heavy charge acceleration in a linear induction accelerator is discussed. Author (NSA)

N68-12625# Iowa State Univ. of Science and Technology, Ames.
INVESTIGATION OF KINEMATIC FITTING RESULTS FOR BUBBLE CHAMBER EVENTS INVOLVING NEUTRAL PARTICLES AT HIGH ENERGIES
W. J. Kernan, T. L. Schalk, L. S. Schroeder, and R. L. Wagstaff
1 Mar. 1967 33 p ref
(Contract W-7405-ENG-82)
(IS-1651) CFSTI: HC $3.00/MF $0.65

A study of the reliability of one-constraint kinematic fits to bubble chamber events involving unobserved neutrons or pions was carried out for high momentum incident particles. The study used events known to be $PP \rightarrow PP\pi^+\pi^-$ at an incident proton momentum of 22 GeV/c. It is shown that a special group of one-constraint events involving high-momentum neutrons can be clearly separated from the background reactions. No general applicability of the results is claimed but the method used is generally applicable. Author (NSA)

N68-12626# Iowa State Univ. of Science and Technology, Ames.
THE USE OF A 40" SCINTILLATION DETECTOR TO MEASURE (GAMMA,N) AND (GAMMA,2N) REACTIONS IN ^{19}F
Christopher Curtiss Jones Aug. 1967 204 p refs
(Contract W-7405-ENG-82)
(IS-1678) CFSTI: HC $3.00/MF $0.65

A high-efficiency neutron detector was used with the Iowa State University electron synchrotron to measure cross sections for the production of neutrons from fluorine at energies up to 50 MeV. The 250 gallons of liquid scintillator were viewed by 28 5-in. photomultiplier tubes. The efficiency as used was 55%. Production rates for reactions in which one or two neutrons were released were computed from a least squares analysis of the probability per beam pulse for observation of k counts, where k varied from zero to nine. Integrated cross sections up to 50 MeV were considerably less than the classical dipole sum, but were generally larger than previous results. The integrated cross section out to 50 MeV for processes in which one or two neutrons are produced is 218±20 MeV-mb. Author (NSA)

N68-12627# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
EXCITATION CURVE OF THE REACTION $^{181}Ta(n,2n)^{180m}Ta$
J. Brzosko, B. Fryszczyn, E. Gierlik, A. Saganek, A. Solton, Jr. et al 1967 15 p refs
(INR-795/I/PL)

The activation method was applied to measure the cross sections producing the isomeric state of ^{180}Ta(8.12 hr) formed in the reaction (n,2n) in the range of neutron energy from 12.2 to 17.9 MeV. The obtained experimental values were compared with those theoretically predicted based on the statistical model. The comparison showed a discrepancy between the experiment and the predictions of the statistical theory with Fermi gas level density. Author (NSA)

N68-12628# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
TWO-CENTER PROBLEM OF QUANTUM MECHANICS. MATHEMATICAL PART [ZADACHA DRUKH TSENTROV KVANTOVOI MEKHANIKI. MATEMATICHESKAYA CHAST]
L. I. Ponomarev and T. P. Puzynina 1966 29 p refs In RUSSIAN
(JINR-P2-3012)

An algorithm is given to calculate the eigenvalues and the wave functions of the two-center problem as well as the matrix elements by these functions. The method of solving the Sturm–Liouville problem for two coupled differential equations of the second order, which is developed here for this case, can be used for other problems. Author (NSA)

N68-12629# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics.
NEUTRON RESONANCES OF ER ISOTOPES [NEITRONNYE REZONANSY IZOTOPOV ERBIYA]
E. N. Karzhavina, A. B. Popov, and Yu. S. Yazvitskii 1967 34 p refs In RUSSIAN
(JINR-P3-3097)

Neutron-transmission and γ-ray yield measurements were made on samples of natural Er and on samples enriched in the isotopes ^{164}Er, ^{166}Er, ^{168}Er, and ^{170}Er. These measurements were made to allow for isotopic identification and for the determination of neutron resonance parameters for ^{164}Er and ^{167}Er in the energy range up to 300 eV, for ^{166}Er up to 1500 eV, and for ^{168}Er and ^{170}Er up to 4000 eV. Other information derived for these isotopes is the average distance between the levels, D; the strength function, S_0; and the radiation width, Γ_γ. An analysis of the data on the strength functions in the range $140<A<200$ confirms the existence of an additional maximum in S_0 at $A \approx 180$. NSA

N68-12631# Columbia Univ., New York.
NEW THEORETICAL VALUES FOR THE LAMB SHIFT
M. F. Soto, Jr. [1966] 8 p refs
(NYO-1932-113) CFSTI: HC $3.00/MF $0.65

A calculation was made to obtain the fourth-order radiative corrections to the energy levels of hydrogenic atoms. NSA

N68-12633# European-American Nuclear Data Committee, Paris (France).
INTENSE NEUTRON SOURCES AND THEIR USES: REPORT OF A GROUP OF EXPERTS, SANTA FE, SEPTEMBER 1966
Mar. 1967 14 p refs
(EAWDC-63(U))

Some recommendations for the development of intense neutron sources are presented; and the applications of intense sources to research in neutron physics, nuclear physics, and condensed matter are briefly discussed with emphasis on the source requirements. NSA

N68-12637# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).

EQUAL TIME COMMUTATORS OF RENORMALIZED CURRENT OPERATORS IN PERTURBATION THEORY WITHOUT CUTOFF

J. Langerholc (Hamburg Univ.) Aug. 1967 39 p refs

(DESY-67/26)

Equal time commutators of finite, renormalized current densities are considered in the first two orders of perturbation theory for the models of photon–nucleon and meson–nucleon interaction. After giving a definition of "equal times" for distributions, the commutators of vector currents in electrodynamics are calculated without the use of a cutoff for the cases where a higher symmetry exists, and where it is broken. Extra terms are found for the $j_{0}j_{0}$ commutator as well as Schwinger terms. Divergences are obtained in this model for the $j_{k}j_{k}$ commutator and for the $j_{0}j_{0}$ commutator in the meson model. Discrepancies arising from the use of a cutoff are discussed and the properties of the extra terms are examined. Author (NSA)

N68-12639# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

CONTRIBUTION TO THE OPTICAL MODEL STUDY BY MEASUREMENT OF REACTION CROSS SECTIONS [CONTRIBUTION AU MODELE OPTIQUE PAR LA MESURE DE SECTIONS DE REACTION]

Jeannine Delaunay (Ph.D. Thesis—Paris Univ., Orsay (France)). 1966 50 p refs In FRENCH

(CEA-R-3091)

Excitation functions of the reaction cross section δR for protons were obtained between 5 and 11 MeV for ^{141}Pr and ^{150}Nd by radioactive techniques and between 9 and 12 MeV for Cu and Ni by the transmission method. Results were compared to predictions of the optical model. Calculations were made to see in what part δR is able to reduce the ambiguities of the optical model. Author (NSA)

N68-12640# Columbia Univ., Irvington, N. Y. Nevis Labs.

η AND η' PRODUCTIONS NEAR THRESHOLDS IN π–P REACTIONS

E. Hyman, W. Lee, J. Peoples, J. Schiff, C. Schultz et al Sep. 1966 21 p refs

(Contract AT(30-1)-1932)

(NEVIS-155; R-563; CU-259) CFSTI: HC $3.00/MF $0.65

An experiment to study the reaction $\pi^{-}+p \rightarrow \eta+n$ near threshold was performed preliminary to a forthcoming measurement of charge asymmetry in η-meson decay. The η was identified by the velocity of the associated neutron. Neutrons produced in the forward hemisphere in the center-of-mass system corresponding to the most energetic neutrons in the laboratory were detected. Data were taken at π^{-} momenta between 670 and 805 MeV/c. The four neutron detectors made it possible to detect neutrons at angles of 0 to 21° from the incident pion beam. Differential cross sections for both pion charge exchange and η production calculated from the data are presented. A search was made for η' at pion momentum of 1.5 BeV/c, and none were observed. The value $\sigma(\pi^{-}p \rightarrow n\eta') \leq 60$ μb was obtained. Author (NSA)

N68-12645# California Univ., Berkeley. Lawrence Radiation Lab.

A BEAM STUDY OF $N_2^+ + H_2$, HD, D_2 REACTION DYNAMICS

W. R. Gentry (Ph.D. Thesis) Sep. 1967 70 p refs Sponsored in part by NSF

(Contract W-7405-ENG-48)

(UCRL-17813) CFSTI: HC $3.00/MF $0.65

An ion beam-collision cell method was used to measure the product energy and angular distributions from reactions of N_2^+ with H_2, HD, and D_2 in the primary ion energy range from 25 to 135 eV. The data include three contour maps each for the H_2 and D_2 experiments (taken at low, intermediate, and high energies) showing the entire distribution of product intensity in the center-of-mass coordinate system. The distributions have a crater-like shape around the center-of-mass point. At large scattering angles the intensity varied slowly with angle, and the velocity at the rim of the crater was independent of angle in the center-of-mass system. All of the distributions had a peak at 0° scattering angle, which showed little spreading in energy or angle over the spread in the primary ion beam. The intensity of this peak was to 3 to 500 times that for large-angle scattering. Kinematic analysis of the distributions showed that all product ions are formed with high excitation energies. The amount of transfer of kinetic energy of the reactants to excitation energy of the products was found to be $\approx$1.75 eV for large-angle scattering, independent of the primary ion energy. For small-angle scattering, energy transfer agreed with predictions of the stripping model for collisions at low energies, but at high collision energies it reached a constant maximum value of $\approx$2.5 eV. This result is interpreted as evidence for N_2+H^+ as the principal dissociation products of N_2H^+. Only isolated features of the product ion distributions agreed with simple collision models, and at high energies strong recoil was kinematically required by the data, even for the forward scattering peaks. Author (NSA)

N68-12653# General Dynamics Corp., San Diego, Calif. General Atomic Div.

TACASI: A FORTRAN 4 CODE FOR LEAST SQUARES AREA ANALYSIS OF NEUTRON RESONANCE DATA

F. H. Froehner 4 Aug. 1966 125 p refs

(Contract AT(04-3)-167)

(GA-6906) CFSTI: HC $3.00/MF $0.65

A computer program, TACASI, for the determination of neutron resonance parameters by least-squares area analysis of neutron resonance data is described. The least-squares formalism is outlined, and a listing of the program is included. NSA

N68-12658# California Univ., Berkeley. Lawrence Radiation Lab.

RESONANCES, PARTICLES, AND POLES FROM THE EXPERIMENTER'S POINT OF VIEW

Geoffrey F. Chew 12 Jul. 1966 36 p refs

(Contract W-7405-ENG-48)

(UCRL-16983) CFSTI: HC $3.00/MF $0.65

Experimenters are urged to adopt the particle-pole correspondence in the interpretation of data. The resulting removal of ambiguities in the characterization of unstable particles is stressed. Author

N68-12687# California Univ., Berkeley. Lawrence Radiation Lab.

MEASUREMENT OF THE ELECTRON-ASYMMETRY PARAMETER OF NEGATIVE SIGMA HYPERON DECAY TO NEUTRON PLUS BETA PLUS ANTI-NEUTRINO

Lawrence K. Gershwin, Margaret Alston-Garnjost, Roger O. Bangerter, Angela Barbaro-Galtieri, Terry S. Mast et al 14 Aug. 1967 11 p refs Presented at the Intern. Conf. on Elementary Particles, Heidelberg, 20–27 Sep. 1967

(Contract W-7405-ENG-48)

(UCRL-17740; CONF-670934-2) CFSTI: HC $3.00/MF $0.65

The up–down asymmetry of electrons from the decay $\Sigma^{-} \rightarrow n+e^{-}+\bar{\nu}$ is examined using polarized Σ^{-}'s produced via the reaction $K^{-}+p \rightarrow \Sigma^{-}+\pi^{+}$ at 400 MeV/c. This leads to a g_A/g_V which somewhat favors the solution B of Willis et al. N5A

N68-12692# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

NEW ANALYTICAL RESULTS FROM SLOWING-DOWN THEORY, AND THEIR APPLICATION TO A CHECKOUT OF THE RBU SLOWING-DOWN ROUTINE

A. G. Gibbs and D. H. Thomsen Nov. 1966 11 p refs

(Contract AT(45-1)-1830)

(BNWL-307) CFSTI: HC$3.00/MF$0.65

The analytical results are compared to Monte Carlo calculations done using the RBU slowing-down routine. The comparison indicates that the routine is working properly. Author (NSA)

N68-12698# Oak Ridge National Lab., Tenn.

NUMERICAL SOLUTIONS OF THE ISOTHERMAL FISSION-PRODUCT DEPOSITION EQUATIONS: THE PROGRAM PREDEP-2

T. S. Kress and Paul Nelson, Jr. Oct. 1967 28 p refs

(Contract W-7405-ENG-26)

(ORNL-TM-1970) CFSTI: HC$3.00/MF$0.65

The heat-mass analogy was previously used to develop a semilinear system of partial differential equations to describe the isothermal deposition of fission products. This system is transformed into a system of integral equations in computationally convenient variables, and a finite-difference method for the solution of the integral equation system is described. A brief description is given of the computer program PREDEP-II, which accepts data in terms of physically convenient dimensionless variables, transforms these to the computational variables for means of solving the finite-difference equations, and finally reports the results in terms of the physical variables. Author (NSA)

N68-12700# Brookhaven National Lab., Upton, N. Y.

POSITIVE Σ^+ DECAY PARAMETERS

D. Berley, S. Herzbach (Mass. Univ.), R. Kofler (Mass. Univ.), S. Yamamoto (Mass. Univ.), W. Heintzelman et al 31 Aug. 1966 18 p refs Presented at the 13th Intern. Conf. on High Energy Phys., Berkeley, Calif. Prepared jointly with Mass. Univ.

(Contract AT(30-1)-3651)

(NYO-3651-1; CONF-660808-18) CFSTI: HC$3.00/MF$0.65

The decay parameters of $\Sigma^+ \rightarrow n+\pi^+$ were measured. The decay occurs through the p wave channel: α_+ is small ($+.047 \pm .07$); the likelihood ratio $(\gamma=-1)/(\gamma=+1)$ is 2×10^4. No evidence was found for a violation of T invariance; defining ϕ by $\beta = \sin\phi$, $\gamma = \cos\phi$, $\phi = 180^\circ \pm 30^\circ$ was determined. Author (NSA)

N68-12704# California Univ., Berkeley. Dept. of Physics.

DYNAMIC ORIENTATION OF NUCLEI

C. D. Jeffries [1967] 27 p refs Presented at the Intern. Conf. on Hyperfine Interactions as Detected by Nucl. Radiation, Pacific Grove, Calif., 28 Aug. 1967 Submitted for publication

(Contract AT(11-1)-34)

(UCB-34P20-OR4; CONF-670812-7) CFSTI: HC$3.00/MF$0.65

A review is given of some methods for orienting nuclei in matter which are distinctly nonthermal equilibrium in nature and are based on the preferential population of nuclear magnetic states by irradiation at some resonance frequency of the system. Microwave dynamic nuclear orientation and nuclear spin cooling are the two broad categories of techniques covered. NSA

N68-12708# Colorado Univ., Boulder. Dept. of Physics and Astrophysics.

TECHNICAL PROGRESS REPORT ON NUCLEAR PHYSICS

Nov. 1966 70 p refs

(Contract AT(11-1)-535)

(UCOL-535-561) CFSTI: HC$3.00/MF$0.65

The optical-model potential was investigated using ^{3}He scattering by medium-weight nuclei. Angular distributions for the reaction ^{12}C(He-3,α)^{11}C and for ^{3}He elastic scattering by ^{12}C at 43.7 MeV were analyzed using the optical model and the DWBA formalism. Angular distributions for proton inelastic scattering by ^{92}Zr and ^{94}Zr were fitted using distorted-wave theory and shell-model form factors. Angular distributions for the ^{96}Zr(p,d)^{95}Zr reaction and for proton inelastic scattering by ^{96}Zr at 18.4 MeV were measured and were calculated; spectroscopic factors were obtained by a distorted-wave analysis of the ^{96}Zr(p,d)^{95}Zr reaction. Level density fluctuations in ^{56}Fe were investigated using proton inelastic scattering, and proton elastic and inelastic scattering by ^{42}Ca and ^{44}Ca at 22.9 MeV was studied experimentally and theoretically. Energy levels in ^{35}Ar, ^{36}K, and ^{37}K were investigated using the reactions ^{36}Ar(p,d)^{35}Ar, ^{36}Ar(He-3,t)^{36}K, and ^{38}Ar(He-3,d)^{37}K. The Coulomb energy systematics of isobaric triplets in the mass region $22 \leq A \leq 40$ were also investigated experimentally. The proton elastic scattering cross section of ^{58}Ni was calculated using a modified optical theorem, and optical-model parameters were investigated using proton elastic scattering by ^{40}Ar, ^{209}Bi, ^{208}Pb, ^{58}Ni, ^{14}N, ^{16}O, ^{116}Sn, and ^{96}Zr. Information on the level structure of ^{88}Sr and ^{89}Y was obtained from angular distributions for proton scattering by ^{88}Sr and ^{89}Y at 19.5 MeV and for the reaction ^{88}Sr(He-3,d)^{89}Y at 37.7 MeV. Proton elastic and inelastic scattering by ^{56}Fe, ^{57}Fe, and ^{58}Fe at 22.5 MeV was also investigated; experimental angular distributions were fitted using the optical model. The (d,p), (p,d), and (He-3,d) reactions on ^{40}Ca were investigated using optical-model wave functions obtained from proton and deuteron elastic scattering by ^{40}Ca; previously unreported levels of ^{39}Ca and ^{41}Sc were observed. Previously unreported levels of ^{57}Ni, ^{88}Y, and ^{89}Zr were observed in a study of the reactions ^{58}Ni(He-3,α)^{57}Ni, ^{89}Y(He-3,α)^{88}Y, and ^{90}Zr(He-3,α)^{89}Zr. A method of measuring the half lives of long-lived radioisotopes was developed; the half lives of ^{36}Cl and ^{41}Ca were measured. Techniques for the fabrication of Ge(Li) detectors were also investigated. NSA

N68-12720# Joint Inst. for Nuclear Research, Dubna (USSR).

TWO-CENTER PROBLEM OF QUANTUM MECHANICS [ZADACHA DVUKH TSENTROV KVANTOVOI MEKHANIKI]

L. I. Ponomarev and T. P. Puzynina 1966 24 p refs In RUSSIAN

(JINR-P2-3009)

The results of numerical calculations of the two-center problem of quantum mechanics are given. Some interesting properties of the systems Z_1eZ_2 are observed for the $Z_1=1$ and $Z_2=3, \ldots$, 8 values. In particular the existence of the σ-term intersections in such a system, which were previously predicted by theory, is proved. The existence of stable states of molecular ions for large distances between the nuclei Z_1 and Z_2 is proved. Such a peculiar phenomenon, pseudointersections of terms, having no dynamical nature is found out. Possible applications of the results obtained are discussed. Author (NSA)

N68-12724# Atomic Energy Establishment, Winfrith (England).

MESH REQUIREMENTS FOR NEUTRON TRANSPORT CALCULATIONS

J. R. Askew Jul. 1967 10 p refs

(AEEW-M-760) CFSTI: HC$3.00/MF$0.65

Fine-structure calculations are reported for a cylindrical natural uranium-graphite cell using both discrete-ordinate and collision-probability code solution methods with the WIMS code, with variations in the spatial mesh. It is suggested that of formulations assuming the source constant in a mesh interval the differential approach is generally to be preferred. Due to cancellation between approximations made in the derivation of the finite difference equations and the errors in neglecting source variation, the discrete ordinate code gave a more accurate estimate of fine structure for a given mesh even for unusually coarse representations. Author (NSA)

N68-12732# Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif.

LINAC MEASUREMENTS OF THE FAST NEUTRON RESPONSE OF ORGANIC SCINTILLATORS

E. Yates, D. Crandall, and J. Kirkbride Nov. 1966 14 p refs Presented at the 13th Nucl. Sci. Symp., Boston, 19–21 Oct. 1966

(Contract W-7405-ENG-48)

(EGG-1183-2100; S-356-R; UCRL-13263; CONF-661020-16) CFSTI: HC $3.00/MF $0.65

The 20-MeV linac at EG&G, Santa Barbara, produces fast neutrons up to 11 MeV by the photoneutron reaction in a beryllium target. With a 10-nanosecond linac burst and a 25-meter evacuated flight path, neutron energy resolutions ranging from 7 percent at 10 MeV to 1.4 percent at 0.4 MeV are obtained. A plastic scintillator identical to that designed by Batchelor was placed at the end of the flight path, and its scintillation output was placed in coincidence with narrow time windows. These windows could be varied in width and position with respect to the linac burst. The scintillations passing through a window were the response of the detector to neutrons of a narrow band of energies. By scanning the window in time, the neutron pulse-height response of the detector was measured for neutrons from 1 to 8 MeV. In a separate experiment the neutron detection efficiency of a 6-inch cube of MEL 150 C plastic scintillator was derived by comparison with Batchelor's detector; that is, the same time-of-flight neutron spectrum was measured by both detectors. This is a new and convenient application of the linac time-of-flight technique for measuring the neutron response and efficiencies of organic scintillators.

Author (NSA)

N68-12734# European Atomic Energy Community, Ispra (Italy). Reactor Physics Dept.

STUDIES OF ^{240}Pu RESONANCE ABSORPTION IN HETEROGENEOUS SYSTEMS

F. Beonio-Brocchieri and E. Diana 16 Aug. 1966 20 p refs

(EUR-3151.E)

Neutron resonance absorption by ^{240}Pu in heterogeneous systems was studied by a method in which detailed spatial distributions in the different regions and energy depression in the moderator were taken into account. The results were compared with experimental data.

NSA

N68-12740# Bettis Atomic Power Lab., Pittsburgh, Pa.

ENERGY BUILDUP FACTORS IN WATER FOR VERY DEEP PENETRATIONS FOR A 6 MEV PLANE ISOTROPIC GAMMA SOURCE

L. Lois Aug. 1966 9 p refs Presented at 14th Conf. on Remote Systems and Technol., Pittsburgh

(Contract AT(11-1)-GEN-14)

(WAPD-T-1932; CONF-661001-32) CFSTI: HC $3.00/MF $0.65

A new formulation for the solution of the linearized Boltzmann transport equation was applied to the gamma-ray transport problem for multilaminar arrays in slab geometry. A program based on this method was constructed and applied to the problem of gamma-ray transport in slab geometry. The slowing-down problem is handled by the group technique. The energy range is divided into regions so that the cross sections are almost constant within each region. Then a sequence of monoenergetic problems is solved for each group.

NSA

N68-12747# Academia R. P. R., Bucharest. Inst. de Fizica Atomica.

SMALL-ANGLE CRITICAL MAGNETIC SCATTERING OF NEUTRONS IN IRON

D. Bally, B. Grabcev, A. M. Lungu, M. Popovici and M. Totia 1966 16 p refs

(IFA-FN-28)

Measurements of the temperature variation of the small-angle critical scattering of 1.25 Å neutrons by iron were performed. Taking into account the inelasticity of the scattering, the parameters which define the instantaneous spin correlation function of Ornstein–Zernicke form were determined. This form of the function turned out to be valid at distances larger than 15–20 Å. For smaller distances, it was confirmed that the instantaneous correlation function has the form of a simple exponential. From the data for $T-T_c>10°C$ it was deduced that the temperature variation of the static magnetic susceptibility is of the form $(T-T_c)^{-(1.30\pm0.04)}$. In the nearest proximity of the critical temperature T_c there were noticed no significant deviation from this dependence.

Author (NSA)

N68-12751# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

MOVEMENT OF AN ELECTRON–ION PAIR IN A MAGNETIC BOTTLE IN PRESENCE OF A PROGRESSIVE WAVE IN CYCLOTRON ELECTRONIC RESONANCE [MOUVEMENT D'UNE PAIRE ELECTRON–ION DANS UNE BOUTEILLE MAGNETIQUE EN PRESENCE D'UNE ONDE PROGRESSIVE A LA RESONANCE CYCLOTRON ELECTRONIQUE]

Felix Brami, Terenzio Consoli, and Georges Ichtchenko Jan. 1967 40 p In FRENCH

(CEA-R-3115)

The particle motion is studied in the complex field configuration of a CIRCE machine, by mean of an analogic computer as a function of initial conditions (an electromagnetic wave propagates along the z axis of a magnetic bottle and produces electron cyclotron resonance at one or both the mirror regions, depending on the attenuation distance). It is shown that the electromagnetic wave can prevent particles from escaping into the loss cone. An analytical solution is found, which is in good agreement with the analogic results.

Author (NSA)

N68-12766# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research

AN ATTEMPT TO DETERMINE VAN HOVE'S OVERLAP FUNCTION AND SHADOW ELASTIC SCATTERING FROM THE MEASUREMENTS OF INELASTIC π^+ P INTERACTIONS AT 8 GEV/C [PROBA WYZNACZENIA FUNKCJI PRZEKRYWANIA VAN HOVE' A I CIENIOWEGO ROZPRASZANIA ELASTYCZNEGO NA PODSTAWIE POMIAROW NIEELASTYCZNYCH ODDZIALYWAN π^+P PRZY PEDZIE 8 GEV/C]

L. Michejda [1967] 42 p refs

(Rept.-825/6/PH)

From the measurements of π^+ p inelastic reactions at 8 GeV/c the Van Hove overlap function is determined assuming no correlations among secondary particles, a constant phase of the wave function and neglecting spins. The overlap functions obtained for various channels are used to compare how much "peripheral" or "central" are these collisions. It was found that the computed overall overlap function violates unitarity bounds on partial inelastic cross sections and is in a striking disagreement with these cross-sections estimated from the elastic differential cross section. It seems that the failure of the calculation is mainly due to the incorrect assumption that the phase of the many-body wave function does not depend on momentum configuration of the final state particles.

Author

N68-12771# Princeton-Pennsylvania Accelerator, Princeton, N. J.

ACCELERATOR BEAM DEGENERATION FROM AMPLIFIED SHOT NOISE

M. V. Isaila, A. Passner, and R. L. Pease 20 Dec. 1966 13 p refs

(Contract AT(30-1)-2137)

(PPAD-609D) CFSTI: HC $3.00/MF $0.65

From observations of, and calculations on, beam degeneration observed under artificial conditions at the Princeton–Pennsylvania Accelerator, it was possible to attribute the degeneration primarily to high-frequency components of ordinary shot noise, amplified in a state of longitudinal instability. Author (NSA)

N68-12775# California Univ., Berkeley. Lawrence Radiation Lab.
ENVIRONMENTAL EFFECTS ON THE DECAY CONSTANT OF NIOBIUM-90
John A. Cooper (Ph.D. Thesis) 2 Sep. 1966 147 p refs
(Contract W-7405-ENG-48)
(UCRL-16910) CFSTI: HC $3.00/MF $0.65

A method was developed to study changes in nuclear decay constants due to alterations in the chemical or physical environment. This method was applied to the study of the effect of chemical state changes, the effect of a large increase in pressure, and the effect of changes into and out of the superconducting state on the decay constant of the 24-sec isomeric state in ^{90}Nb. The results showed that the energy of the transition depopulating this isomeric state is very low and that an appreciable fraction of the isomeric decay takes place by ejection of valence electrons. The gamma spectrum of ^{90}Mo was also investigated. Several previously unreported lines were observed, and the photon intensities were measured. The multipolarities of many of the intense transitions were determined and their coincidence relations were resolved with gamma–gamma coincidence studies. A decay scheme was postulated from which the energy of the transition depopulating the 24-sec isomeric state was determined from energy differences to be 2.38±0.36 keV. Author (NSA)

N68-12779# Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics.
NEWLY OBSERVED GAMMA TRANSITIONS IN ^{151}TB AND ^{152}TB DECAYS
J. Kormicki, H. Niewodniczanski, Z. Stachura, K. Zuber, and A. Budziak Jun. 1966 33 p refs Transl. into ENGLISH from Polish
(INP-481/PL)

The internal conversion-electron spectrum of the decays of ^{151}Tb and ^{152}Tb in the energy range from 30 to 600 keV was measured using a semicircular beta spectrograph. The activities were produced by spallation of Ta nuclei with 660-MeV protons. The energies and relative intensities of conversion lines were measured. For some transitions, the multipolarities and mixing ratios were also determined. Twelve gamma transitions in ^{151}Gd and ^{152}Gd nuclei based on a number of newly observed conversion lines in the ^{151}Tb and ^{152}Tb decays were determined for the first time. Author (NSA)

N68-12785# Sandia Corp., Albuquerque, N. Mex.
ELECTRON EMISSION FROM A (100) TUNGSTEN SURFACE UNDER PROTON BOMBARDMENT
Ronald I. Ewing Nov. 1966 7 p ref Presented at Am. Phys. Soc. Meeting, Nashville, Tenn.
(Contract AT(29-1)-789)
(SC-DC-66-1559; CONF-661208-1) CFSTI: HC $3.00/MF $0.65

The yield of electrons from a clean (100) surface of tungsten under bombardment by protons at normal incidence is reported as a function of proton energy in the range 50 to 225 keV. The maximum value of the yield is 1.51±0.03 electrons per incident proton at a proton energy of 125 keV. The yield from the (100) plane surface fell 11±2% below the yield from a polycrystalline surface. The tungsten surface was cleaned by flash heating a single crystal tungsten ribbon at 2400°K in a vacuum chamber in which the total pressure was about 2×10^{-10} torr. The yield was measured with the surface at room temperature, about two minutes after the surface was cleaned, while the time for a monolayer of residual gases to form on the surface was greater than two hours. Author (NSA)

N68-12787# California Univ., Berkeley. Lawrence Radiation Lab.
COMPILATION OF EXPERIMENTAL E α VALUES IN THE REGION ABOVE Z=81 AND BELOW N=128
Kalevi Valli Aug. 1967 29 p refs Presented at the 3rd Intern. Conf. on Atomic Masses, Winnipeg, Canada
(Contract W-7405-ENG-48)
(UCRL-17723; CONF-670818-3) CFSTI: HC $3.00/MF $0.65

Alpha-particle energies, alpha-decay energies, alpha branches, and half-lives are presented for Ac, Bi, Fr, Ra, Rn, and Th isotopes with N<128 and Z>81. At isotopes lighter than ^{206}At, Po isotopes lighter than ^{204}Po, and some recent results on ^{208}At and ^{209}At are also listed. NSA

N68-12788# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
TERNARY FISSION OF NUCLEI INDUCED BY HEAVY IONS [DELENIE YADER TYAZHELYMI IONAMI NA TRI OSKOLKA]
S. A. Karamyan, I. V. Kuznetsov, Yu. Ts. Organesyan, and Yu. E. Penionzhkevich 1966 17 p refs In RUSSIAN
(JINR-P7-3063)

Fission into three fragments of approximately equal mass was observed while bombarding ^{197}Au, ^{209}Bi, and ^{238}U with 8-MeV/nucl. ^{22}Ne and ^{40}Ar ions. Semiconductor surface-barrier detectors were used to record the ternary fission. The experimental results can be explained by the mechanism of cascade fission of an excited nucleus when an iterative fission of a heavy fragment accompanies an asymmetrical binary fission. Author (NSA)

N68-12799# Army Nuclear Defense Lab., Edgewood Arsenal, Md.
A DETECTOR ANGLE INTEGRATION PROGRAM DESIGNED TO OPERATE ON THE NGM CODE OUTPUT
W. Charles Hampton Jun. 1967 30 p Supported in part by DASA
(NDL-TM-37; AD-654503)

The Los Alamos Scientific Laboratory (LASL) is preparing a neutron gamma Monte Carlo (NGM) transport code that will provide differential data for use in mapping the initial radiation environment created by a nuclear detonation. The NGM output provides fluxes at a series of detectors, normalized to one neutron that leaves the source in the given source-energy solid-angle group, by appropriately weighting the output and integrating it with respect to the variables. The radiation field of given weapons can be mapped. A set of codes has been generated at US Army nuclear defense laboratory (USANDL) for use in integrating the fluxes over the variables (source energies and angles, detector energies, angles and times), with appropriate weighting where necessary to provide input for special problems. The report describes a digital computer program written for the Ge-225 computer (16K core storage and 6 magnetic tape drives) in the Ge-220 series tape Fortran language, the program integrates the LASL NGM radiation transport code differential flux output, weighted by a user-supplied function, with respect to the detector-angle variables. The resultant output is the flux at the detectors, integrated over detector angles, appropriately weighted for anisotropy of detector response. TAB

N68-12806# Tokyo Univ. (Japan). Inst. for Nuclear Study.
ANNUAL REPORT, APRIL 1965–MARCH 1966
Mar. 1966 106 p refs
(NP-16498)

Maximum energy of the electron synchrotron has been increased from 750 MeV to 1.3 GeV. Preparatory design of the new proton synchrotron continued. Brief accounts are given of the status of various research projects in low and high energy physics, cosmic ray physics, chemical analysis, and theoretical physics. E.C.

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N68-11928# Atomics International, Canoga Park, Calif.
NON-EQUILIBRIUM IONIZATION IN A POTASSIUM GAS MHD DEVICE Final Report
Charles A. Guderjahn Sep. 1967 58 p refs
(Contract AF 49(638)-01721)
(AI-67-138; AFOSR-67-2176; AD-660882)

A theoretical and experimental study of the plasma properties and fluid mechanisms of an annular magnetohydrodynamic generator operated in the Hall mode and driven by potassium gas is described. Nonequilibrium ionization is observed but is accompanied by concentration of current into streamers in the generator and reduction in the expected Hall voltage. As a consequence, the generator efficiency is reduced to zero. Author (TAB)

N68-12009# Air Force Cambridge Research Labs., Bedford, Mass. Microwave Physics Lab.
ELECTRICAL CONDUCTIVITY OF MAGNETOPLASMAS. PART 1: GENERAL THEORY OF EFFECTIVE PARAMETERS
P. M. Bakshi (Brandeis Univ.), R. E. Haskell (Oakland Univ.), and R. J. Papa Sep. 1967 32 p refs
(AFCRL-67-0527; AD-660809)

The use of effective parameters to take into account the velocity dependence of the electron neutral collision frequency is reviewed. The concept of an effective collision frequency and an effective plasma frequency is applied to wave propagation in weakly ionized magnetoplasmas. The relationship between these effective parameters and a new collisional response function R(y) is described. Curves are presented of the effective parameters as a function of frequency for both a pure power law dependence of the collision frequency on electron velocity and for the case of a coupling between two power law variations. The isotropic part of the electron distribution is taken to be Maxwellian. Author (TAB)

N68-12034# Air Force Cambridge Research Labs., Bedford, Mass. Microwave Physics Lab.
ELECTRICAL CONDUCTIVITY OF MAGNETOPLASMAS. PART 2: EFFECTIVE PARAMETERS FOR NON-MAXWELLIAN DISTRIBUTIONS Interim Scientific Report
R. E. Haskell (Oakland Univ., Rochester, Mich.), R. J. Papa, and P. M. Bakshi (Brandeis Univ.) Sep. 1967 29 p refs
(AFCRL-67-0528; RP-343; AD-660810)

For a magnetoplasma in a strong ac electric field, it is possible to derive an expression for the isotropic part of the electron distribution function that depends upon the polarization and intensity of the ac field. In Part I (AD-660 809), it was shown how the applicability of a constant collision frequency model of wave propagation in magnetoplasmas may be extended to include velocity dependent collisions by introducing an effective collision frequency and an effective plasma frequency. In addition to being functions of signal frequency and the type of power law dependence of the collision frequency on electron velocity, the effective plasma parameters are now also functions of the ellipticity and intensity of the ac field, since these effective parameters depend upon the form of the electron distribution function. Curves are presented of the effective parameters as a function of normalized frequency, normalized field strength and dependence of collision frequency on electron velocity for the case where only pure (unmixed) modes are present in the magnetoplasma. Author (TAB)

N68-12149# Columbia Univ., New York. Electronics Research Labs.
THE FLUID TRANSPIRATION ARC AS A RADIATION SOURCE FOR SOLAR SIMULATION Semiannual Progress Report, 1 Jan.–30 Jun. 1967
C. Sheer and S. Korman 30 Jun. 1967 37 p refs
(Contract AF 49(638)-1395)
(P-3/312; AFOSR-67-2363; AD-661285)

The report covers progress to develop a fluid transpiration arc radiation source for solar simulation. The background of the fluid transpiration arc, including a discussion of both the cylindrical offset and conical coaxial geometries, is presented. A description of certain features that offer possibilities of improved source performance is also included. In particular, the high ionization of the FTA anode column plus the effectiveness of high velocity cathode injection to enhance brightness and inhibit cathode ablation has led to a new concept for a plasma source. This involves a colinear opposing flow geometry to generate a large stagnant zone in the arc region of maximum excitation. A preliminary successful experiment on this configuration of 1 atm. pressure is described. The report also described design and procurement of the first source of this type designed to operate at high pressures, including pressure vessel and recirculation system, as well as a complete system for radiometric and measurements. Author (TAB)

N68-12168# Florida Univ., Gainesville. Engineering and Industrial Experiment Station.
ENERGY CONVERSION PLASMA RESEARCH Annual Report, 1 Feb. 1966–31 Aug. 1967
R. T. Schneider, W. F. Fagen, W. H. Bloss, and S. Metz 31 Aug. 1967 57 p refs
(Contract Nonr-580(19))
(AR-1; AD-661327)

An experimental apparatus was built consisting of power supply and discharge tube, which is capable of generating a powerful gas discharge on a pulsed basis. Short duration, high voltage pulses are applied to external electrodes. The resulting strong electric field gradient causes the gas (hydrogen under low pressure) inside the tube to become ionized and thus forming a plasma. This type of plasma is characterized by a high degree of ionization, rather high electron temperature and low ion temperature (nonequilibrium plasma) and is known as quasi-steady high frequency discharge. The main part of the electric power input is converted into plasma radiation disregarding small losses due to ohmic heating. Observed x-ray radiation as well as microwave oscillations and light emission are a function of the plasma characteristics such as electron temperature and density. Author (TAB)

N68-12284# Stanford Univ., Calif. Inst. for Plasma Research.
STUDIES OF PLASMA OSCILLATIONS Quarterly Status Report, Dec. 1, 1966–Feb. 28, 1967
F. W. Crawford Mar. 1967 49 p refs
(Contract AT(04-3)-326)
(SU-IPR-145) CFSTI: HC $3.00/MF $0.65

Further research developments are reported on the following areas: ion wave propagation and positive column instabilities, electron beam probing of plasma-cyclotron echoes, beam-plasma interactions, and positive column resonances and propagation. NSA

N68-12338# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Atomnoi Energii.
RECOMBINATION OF POSITIVE IONS WITHIN PLASMAS [REKOMBINATSIYA POLOZHITEL'NYKH IONOV V PLAZME]

B. M. Smirnov 1966 56 p refs In RUSSIAN
(IAE-1085)

The author surveys the theoretical aspects and experimental data on recombination of positive ions and electrons or negative ions within plasmas on the basis of 125 references. The discussion of triple and collision–radiation recombinations is followed by a description of the recombination of ionized atoms, and electrons through the formation of a self-ionization state, the recombination with the participation of negative ions, the recombination of ionized molecules, and the transitions between atomic and molecular levels. Data on recombination coefficients reported by various researchers are compared in comprehensive tables. NSA

N68-12343# Michigan Univ., Ann Arbor. Electron Physics Lab.
COMPUTER SIMULATION OF PLASMA DIODES. PART 3 Final Report, 1 Jun. 1963–31 Dec. 1966
J. E. Rowe Jun. 1967 47 p refs
(Contract DA-36-039-AMC-02269(E))
(ECOM-02269-F3; Rept.-12, TR-100. Pt. 3; AD-661302)

The multistream plasma diode was simulated on a digital computer using a particle dynamics approach to evaluate the effects of collisions, finite emitter temperatures, d-c electric fields and static magnetic fields on the development of r-f currents in the diode. The nonlinear coupling of the streams is considered and specific computer results are presented and discussed for a variety of diode operating conditions. Elastic collisions between the drifting charge carriers and neutral gas molecules act as a dissipative mechanism which inhibits the energy transfer between streams. For large velocity separations the streams are essentially uncoupled and behave ballistically. Author (TAB)

N68-12360# General Electric Co., Philadelphia, Pa. Missile and Space Div.
DENSITY PROFILE MEASUREMENTS Final Report
P. Gloersen Sep. 1967 56 p refs
(Contract AF 49(638)-1578)
(AFOSR-67-2364; AD-660588)

Plasma densities were measured in the exhaust stream of a repetitively fired coaxial plasma gun. Species in the exhaust were identified and their density and velocity profiles were obtained. The experimental results were compared with those anticipated on the basis of existing theoretical models. The results also were found to be in substantial agreement with conclusions reached from other measurements such as thrust, mass flow, and total energy in the exhaust stream. The measuring techniques that were involved were as follows: For the xenon neutral atoms, vacuum ultraviolet absorption spectroscopy; for the xenon ions (and also impurity ions), a Langmuir probe biased to collect ions; and for particle identification of luminous species in the exhaust, emission spectroscopy in the VUV region. The number density of the xenon ions turned out to be marginally low for optical detection and, furthermore, the background light source produced ion lines of sufficiently low intensity so that pulse-sampling would have been required to obtain the desired results. Author (TAB)

N68-12377# Northwestern Univ., Evanston, Ill.
EXPERIMENTAL MEASUREMENT OF THE EMISSION AND ABSORPTION OF RADIATION BY AN ARGON PLASMA
D. L. Evans and R. S. Tankin Wright-Patterson AFB, Ohio ARL Jul. 1967 141 p refs
(Contract AF 33(615)-1160)
(ARL-67-0157; AD-660576)

A thermistor bolometer was used to obtain spatially resolved measurements of the total radiation of an argon plasma in the spectral ranges of 0.2 to 3.5 microns and 0.2 to 22 microns. The measurements were correlated with temperature at pressures of 0.5, 1.0 and 2.0 atmospheres. The use of a free burning arc as a source allowed measurements at temperatures from 10,000 to 26,000K. Spectroscopic measurements and the well known Fowler-Milne technique were used to determine the temperature. For the one atmosphere case, absorption measurements were made so that the emission results could be corrected for absorption. Corrections for the ultraviolet radiation were also made and results are compared with existing theories and data. Measured values agree well with those made by Avco while corrected values are close to those of Emmons. The 6965.43 Al line was also studied. Line shifts, 1/2-halfwidths, absorption coefficients and emission coefficients were measured. Transition probabilities from both emission and absorption studies are found to be in agreement. The value obtained is within the experimental error of Olsen. Author (TAB)

N68-12405# Laboratoire de Recherches sur la Physique des Plasmas, Lausanne (Switzerland).
MEASUREMENT OF THE TRANSITION PROBABILITIES OF SOME C2 AND C3 LINES [MESURE DES PROBABILITES DE TRANSITION DE QUELQUES RAIES DE C2 ET C3]
J. Durand Dec. 1966 28 p refs In FRENCH; ENGLISH summary
(LRP-29/66)

The measurement of the transition probabilities of C 3 and C 2 is described. This measurement is made in a dense plasma (3×10^{16} cm^{-3}) having a temperature between 2.5 and 4×10^{4}°K. Author (NSA)

N68-12453# Princeton Univ., N. J. Plasma Physics Lab.
INTERCHANGE INSTABILITIES IN IDEAL HYDROMAGNETIC THEORY
John M. Greene and John L. Johnson Feb. 1967 23 p refs
(Contract AT(30-1)-1238)
(MATT-447) CFSTI: HC$3.00/MF$0.65

Interchange instabilities are examined using an ideal hydromagnetic model so that the nature of the energy sources which can drive the instability is clarified. A generalization of V''(ψ) is determined. Author (NSA)

N68-12500# Laboratorie de Recherches sur la Physique des Plasmas, Lausanne (Switzerland).
PLASMA CONFINEMENT BY A ROTATING FIELD. STABILITY OF PLASMA-GENERATING SYSTEM [CONFINEMENT D'UN PLASMA PAR CHAMP TOURNANT. LA STABILITE DU SYSTEME GENERATEUR-PLASMA]
Erich S. Weibel Aug. 1966 14 p In FRENCH
(LRP-27/66)

The rf generators supplying the power to build up the confining fields and to heat the plasma are coupled to the latter optimally as described previously. The low-frequency stability of this system is analyzed, taking into account the increase in time of the plasma temperature and of the field amplitude. The system is shown to be stable. Author (NSA)

N68-12501# Royal Inst. of Tech., Stockholm (Sweden). Div. of Electron and Plasma Physics.
PENNING DISCHARGE IN A STRONGLY INHOMOGENEOUS MAGNETIC MIRROR FIELD
N. Hopfgarten, R. B. Johansson, B. Nilsson, and H. Persson 25 May 1967 10 p refs
(NP-16805)

An attempt was made to produce an electric field parallel to the magnetic lines of force in a Penning discharge in a strongly inhomogeneous magnetic mirror field. This was found to be

theoretically possible for a collisionless plasma in an inhomogeneous magnetic field provided there is anisotropy in the velocity distributions of ions and electrons. NSA

N68-12513# Dartmouth Coll., Hanover, N. H.
ELECTRICAL CONDUCTION FROM A LAMINAR ARC HEATED FLOW TO A COOLED CYLINDRICAL ANODE
Final Scientific Technical Report
P. W. Runstadler, Jr. Wright-Patterson AFB, Ohio ARL Jul. 1967 88 p refs
(Contract AF 33(657)-8179)
(ARL-67-0142; AD-660571)

An investigation was made of the electrical conduction in an arc heated atmospheric pressure plasma flow passing through a ring anode. The arc plasma flow is maintained in a tube between an upstream cathode and an anode at the tube exit. A test ring anode upstream of the primary anode is biased relative to its floating potential permitting current to be drawn to the flowing plasma. Anode characteristics were measured for helium and argon in a one centimeter duct at atmospheric pressure. Experiments have included copper, nickel, molybdenum, silver, magnesium, tungsten, aluminum, and iron as anode materials. Electrical conduction to the anode is found to be a function of arc gas type, main arc current, anode material, and anode geometry for a fully developed flow in a fixed tube size. Electrical conduction is strongly dependent upon the cleanliness of the apparatus. At low bias currents, electrical conduction tends to be uniformly distributed over the anode surface in the circumferential direction. At higher levels of bias current, non-uniform electrical conduction distributed over a small surface area (anode spots) usually occurs. A theory was developed for conduction in helium for low bias currents. Author (TAB)

N68-12537# Texas Univ., Austin. Labs. for Electronics and Related Science Research.
BREAKDOWN MECHANISMS FOR LASER-INDUCED DISCHARGES IN SUPER-HIGH PRESSURE GASES
Arwin A. Dougal and Dennis H. Gill 1967 6 p refs Presented at the 8th Intern. Conf. on Phenomena in Ionized Gases, Vienna, 27 Aug.–2 Sep. 1967
(Grants AF-AFOSR-766-67; NSF GP-1511)
(AFOSR-67-2497; AD-660567)

The paper presents the results of validation experiments on the effects of laser induced breakdown of super-high pressure gases (7 to 2000 atmospheres). It was determined that the optical extension of the classical diffusion - controlled microwave breakdown theory correctly predicts a minimum in the electric field vs. pressure curve. The experiments identify electron impact as the responsible breakdown mechanism. Author (TAB)

N68-12547* Polytechnic Inst. of Brooklyn, Farmingdale, N. Y.
MEASUREMENTS OF THE IONIZED FLOW IN A SHOCK TUNNEL BY MEANS OF RESONANT CAVITIES AND ELECTROSTATIC PROBES
Martin H. Bloom and Samuel Lederman 20 Nov. 1967 80 p refs
(Grant NsG-409)
(NASA-CR-66513) CFSTI: $3.00 CSCL 20I

Experiments were conducted on the non-equilibrium electron density distribution in a hypersonic shock tunnel. Electron number density surveys have been made using S-band microwave resonant cavities and biased electrostatic probes. Electron temperatures of 3000°K were measured using the classical Langmuir probe theory. The feasibility of obtaining electron density profiles around bodies in hypersonic flows has been demonstrated. Finally, surface probe ion current distributions around a blunt body were shown to correlate with neutral density distributions. Author

N68-12562# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
NUMERICAL AND EXPERIMENTAL INVESTIGATIONS ON COLLISIONFREE COMPRESSION OF A PLASMA WITH ANOMALOUS FRICTION
R. Chodura and P. Igenbergs [1966] 13 p
(CONF-661041-14)

Friction of electrons moving under the action of an induced electric field in a dilute collisionless plasma was investigated by comparison of numerical calculations with experimental results. Calculations were made for a cylindrical plasma in an axial time-varying magnetic field. The behaviour of the plasma was treated by two-fluid equations including a friction term for the electron component. This term forces the electron velocity to stay under a critical value and simultaneously describe the conversion of energy of directed motion in energy of unordered motion. The investigations were made in a density regime 2×10^{11} to 5×10^{12} cm^{-3} where the characteristic length c/w_{pe} for the structure of magnetic field, density etc. is comparable to or larger than the radius of the plasma. In this case there are no limitations on the strength of the induced field, which are imposed in the other case by an unadmissible steepening of the front of the compression wave. Calculated current distributions are compared with probe measurements of magnetic fields. Author

N68-12563# Michigan Univ., Ann Arbor. Electron Physics Lab.
EXPERIMENTAL INVESTIGATION OF THE LOW-VOLTAGE ARC IN NOBLE GASES, PART 5 Final Report, 1 Jun. 1963–31 Dec. 1966
R. J. Martin (Ph.D. Thesis) Jun. 1967 184 p refs
(Contract DA-36-039-AMC-02269(E))
(Rept.-12, Pt. 5; ECOM-02269-F4, Pt. 5; TR-101; AD-661073)

The low-voltage arc mode of the hot-cathode discharge in noble gases was studied experimentally in planar geometry by means of guardringed Langmuir probes. Measurements show that if there is ample electron emission from the hot cathode two stable high-current, low-voltage discharge modes exist in the noble gases; these are the low-voltage arc and the ball-of-fire mode. Neither mode is obtained in hydrogen. Measurements of the steady-state characteristics of the low-voltage arc were predominantly in neon; xenon and argon were also investigated. The peak plasma potentials measured within the low-voltage arc were approximately 14, 8 and 4.5 volts for neon, argon and xenon, respectively. Measurements on the hot-cathode discharge in neon with small admixtures of hydrogen indicate that cumulative ionization is important for the generation of the low-voltage arc. The study of the effect of a Penning impurity upon the low-voltage arc indicates that less than 0.06 percent by volume of the Penning impurity affects the discharge plasma. Author (TAB)

N68-12582# Michigan Univ., Ann Arbor. Electron Physics Lab.
LOW-VOLTAGE ARC STUDIES, PART 5 Final Report, 1 Jun. 1963–31 Dec. 1966
R. J. Lomax, R. J. Martin, J. E. Rowe, and S. N. Salinger Jun. 1967 110 p refs
(Contract DA-36-039-AMC-02269(E))
(Rept.-12; ECOM-02269-F5; AD-661304)

A summary of the first four parts of the final report is presented. In parts I, II and III, analytical models are developed to study various aspects of the behavior of plasmas such as are present in the low-voltage arc. The approach in Part I is based on the transport equation and concentrates on the time-dependent behavior of the plasma. In Part II a ballistic model is used and the existence and propagation of waves in the plasma are investigated. Such waves arising from plasma oscillations are normally present in gas discharges and probably play an important part in energy exchange. Part III describes a Monte Carlo simulation of the low-voltage arc which incorporates many effects such as inelastic

collisions which are virtually impossible to include in any other form of mathematical model. A detailed experimental investigation of the low-voltage arc in noble gases is described in Part IV, some results of which are used in Part III. Measurements were made in neon, xenon, and argon of the potential distribution, electron density distribution and electron temperature. Cumulative ionization was investigated by introducing a small amount of hydrogen. The results indicate that this is an important mechanism. Some measurements were made on the effect of impurities which indicate that impurity effects were negligible in all of the other measurements. Author (TAB)

N68-12807# Stanford Univ., Calif. Inst. for Plasma Research.
BEAM/PLASMA INTERACTION: A COMPARISON OF SYMMETRIC AND TRANSVERSE MODULATION
E. E. Abraham Nov. 1966 59 p refs
(Contract AT(04-3)-326)
(SU-IPR-114) CFSTI: HC $3.00/MF $0.65

Although a great deal of work has been carried out in the past on beam/plasma interactions, all of the numerical studies of the dispersion relation and nearly all of the experimental work have been for the axisymmetric mode. A derivation of the cold plasma dispersion relation is presented for an arbitrary number of azimuthal variations. A similar analysis is presented for the case of beam/plasma interaction in a warm plasma. The results of numerical computations of these dispersion relations are then presented and compared for the cases of axisymmetric and transverse modulation. The results of a stability analysis of the two cases are also presented. Experiments showing gain in both modes are described and additional confirmation that the transverse mode was observed is provided by a Faraday rotation experiment. Author (NSA)

N68-12619# Stanford Univ., Calif. Inst. for Plasma Research.
STUDIES OF PLASMA OSCILLATIONS Quarterly Status Report, 1 Sep.–30 Nov. 1966
F. W. Crawford and M. Chodorow Dec. 1966 59 p refs
(Contract AT(04-3)-326)
(SU-IPR-124) CFSTI: HC $3.00/MF $0.65

Further studies on the following are reported: ion wave propagation and positive column instabilities, electron beam probing of plasmas, beam/plasma interactions, and positive column resonances and propagation. NSA

N68-12661# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
EFFECT OF A RADIAL SPACE-CHARGE FIELD ON THE MOVEMENT OF PARTICLES IN A MAGNETO-STATIC FIELD AND UNDER THE INFLUENCE OF A CIRCULARLY POLARIZED WAVE [L'EFFET D'UN CHAMP DE CHARGE D'ESPACE RADIAL SUR LE MOUVEMENT DES PARTICULES DANS UN CHAMP MAGNETIQUE STATIQUE ET SOUS L'ACTION D'UNE ONDE POLARISEE CIRCULAIREMENT]
Antonio Buffa Jun. 1967 65 p refs In FRENCH
(CEA-R-3262)

The effect of a circularly polarized wave on a cylindrical plasma in a axial magnetostatic field and a radial space-charge field proportional to r is studied. Single particle motion is considered. The electrostatic field produces a shift in the cyclotron resonance frequency and, in case of high charge density, a radial movement of the off-resonance particles. In these conditons a radio-frequency particle resonance is also possible called "drift resonsnce." The drift resonance can be produced with whistler mode, and may be employed in ion acceleration. Afterwards parametrical resonances produced by space-charge field oscillations and collisonal limits of theory are studied. Cases in which ion acceleration is possible are considered on the basis of a quantitative analysis of results. Author (NSA)

N68-12777# Stanford Univ., Calif. Inst. for Plasma Research.
STEADY-STATE THEORY OF AN INTERMEDIATE-PRESSURE DISCHARGE COLUMN IN A MAGNETIC FIELD
H. N. Ewald, F. W. Crawford, and S. A. Self Oct. 1966 32 p refs
(Contract AT(04-3)-326)
(SU-IPR-105) CFSTI: HC $3.00/MF $0.65

A steady-state theory of a discharge column in a magnetic field is presented for the intermediate pressure range where the ion mean free path is neither much greater than, nor much less than, the discharge radius. The analysis is based on continuity and momentum transfer equations for the electron and ions, but in contrast to linear ambipolar diffusion theory the nonlinear ion inertia term is retained. In the plasma approximation, retention of this term gives rise to a plasma sheath boundary, where the density is non-zero and the potential finite located where the ambipolar drift velocity reaches the isothermal sound speed. Numerical solutions are presented for the profiles of density, velocity and potential, for planar and cylindrical discharges. These indicate that potential inversion can occur, and that under such conditions the potential rises to a maximum and then decreases towards the plasma/sheath boundary. With increasing pressure and magnetic field, the solutions tend to those obtainable from ambipolar diffusion theory. With decreasing pressure they approximate low-pressure discharge theory based on the use of the third moment equation for the ions. Author (NSA)

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N68-11992# Naval Ordnance Lab., White Oak, Md.
THE PIEZORESISTANCE EFFECT IN P-TYPE PBTE
James Richard Burke, Jr. 9 Mar. 1967 226 p refs
(NOLTR-66-55; AD-661223)

The piezoresistance effect was measured in 21 single crystal samples of p-type PbTe. The piezoresistance coefficients pi sub 11, pi sub 12 and pi sub 44 were obtained by application of hydrostatic pressure, and uniaxial stresses in different crystallographic orientations. The temperature dependence of these coefficients was investigated in the range 300 K to 77 K for hole concentrations between 4.04 x 10 to the 17th power and 4.94 x 10 to the 19th power cu cm. The results of these measurements are discussed in terms of the band structure and transport properties of the material. Author (TAB)

N68-12002# Library of Congress, Washington, D. C. Aerospace Technology Div.
THE NATURE OF ANOMALOUS PHOTOVOLTAGES IN THE LIGHT OF SOVIET RESEARCH
Zygmunt Litynski *In its* Foreign Sci. Bull., Vol. 3, No. 11 Nov. 1967 p 1-27 refs (See N68-12001 03-34)

Solutions to anomalous photovoltage phenomena, incorporating the nature of the effect of surface recombination and the gradient of trap concentration, are discussed. The long decay time of the photovoltages observed in several materials was also studied, and experiments are proposed to determine the nature of the phenomenon. Soviet research efforts regarding the larger than gap photovoltages in bismuth, lead, cadmium, and antimony chalcogenide films, are summarized. L.S.

N68-12007# California Univ., La Jolla. Dept. of Physics.
SPATIAL VARIATIONS OF THE ORDER PARAMETER IN SUPERCONDUCTORS CONTAINING MANGETIC IMPURITIES
Jean Heinrichs 18 Oct. 1967 40 p refs
(Contract Nonr-2216(11))
(TR-49; AD-660663)

The problem of spatial variations of the order parameter in the vicinity of a paramagnetic impurity and near the transition temperature is reconsidered by means of a more rigorous formalism than in a discussion which appeared recently in the literature. General expressions are derived for the spatially inhomogeneous part of the order parameter and its effect on the critical temperature in the limit of very small concentrations of impurities. A detailed analysis shows that the dominant variations of the order parameter range to a distance of the order of the coherence length from a single impurity, but that this parameter also exhibits weak long-range variations. Both smooth spatial variations and fast oscillations show up in the expression of the superconducting order parameter. In the Born approximation the result for the transition temperature coincides with that of the Abrikosov-Gorkov theory where the average value of the order parameter is used. The next order correction, due to spatial variations, leads to a small increase of the transition temperature, which is explicitly estimated. TAB

N68-12101*# Delaware Univ., Newark. Dept. of Physics.
DARK CONDUCTIVITY OF CDS AS A FUNCTION OF S-VAPOR PRESSURE DURING HEAT TREATMENT BETWEEN 500° AND 700°C
K. W. Boer and W. J. Nalesnik [1967] 24 p refs
(Grant NsG-573; Contract Nonr-4336(00))
(NASA-CR-91140; TR-20; AD-661191) CFSTI: HC $3.00/MF $0.65 CSCL 20L

The dark conductivity of CdS as a function of the sulfur vapor pressure is investigated during heat treatment in a temperature range 500 < T < 700C. The pressure dependence follows j equivalent to (p sub S) to the minus 1/m power with m = lx, l being the average number of sulfur atoms per molecule. For 500 < T < 525C, x = 3, for 525 < T < 630C, x = 1 and for 630 < T < 700C, x = 1. These results are explained by thermodynamic disorder and a Cd-rich nonstoichiometric equilibrium below 525C. Schottky-Wagner disorder most probably is dominant above 525C. The energy of doubly ionizing a sulfur vacancy is E sub c - E sub (V sub s) = 0.48 ev. Author (TAB)

N68-12103# Army Electronics Labs., Fort Monmouth, N. J. Electron Tubes Div.
MICROWAVE PROPERTIES OF SINGLE-CRYSTAL NICKEL-ZINC FERRITES
Samuel Dixon, Jr. and Joseph W. McGowan Sep. 1967 9 p refs
(ECOM-2878; AD-661077)

Data are given on ferrimagnetic resonance properties in annealed (1000C) single-crystal, nickel-zinc ferrite spheres taken at 9.3 GHz and between 4.2K and room temperature. Because of the high saturation magnetization, 4 pi M sub s = 5000 plus or minus 100 gauss, the dc magnetic field for subsidiary ferrimagnetic resonance is coincident with the field for uniform precessional resonance for f < or = 9.5 GHz. At 4.2K, Delta H(111) = 6.9 Oe, rises to 9.1 Oe at 15K, and is 5.8 Oe at room temperature. At room temperature h sub c = 3 mOe, from which it is deduced that the intrinsic linewidth Delta H sub k approaches 0 = 1.3 Oe. An experimental power limiter, operating at 9.55 GHz, utilizing this material, yielded an insertion loss of 0.75 dB with a 3-dB bandwidth of 1.5 GHz. A threshold power limiting level of 50 mW is achieved with a dynamic range of 23 dB. Author (TAB)

N68-12109# Brown Univ., Providence, R. I.
ELECTROLYTIC GROWTH AND PREPARATIONS OF TRANSITION METAL COMPOUND SINGLE CRYSTALS
Technical Report, 1 May 1966–30 Apr. 1967
Aaron Wold Wright-Patterson AFB, Ohio AF Mater. Lab. Jul. 1967 38 p refs
(Contract AF 33(615)-3844)
(AFML-TR-67-239; AD-660615)

Single crystals of NbSe2, and WSe2 were grown by a chemical transport technique. The conductivity of NbSe2 which is metallic, varies from 5.5 ohm-cm at 300K to 28 ohm-cm at 100K. It has a superconducting transition temperature at 7K. WSe2 is a p-type semiconductor - conductivity 0.72 ohm-cm at 298K and 120 ohm-cm at 77K. The thermoelectric figure of merit of Ta substituted WSe2 is 0.0005/(deg. K) from 773K to 1273K. Single crystals of Fe(II)0.Fe2(III)03 were grown by chemical transport utilizing HCl as the volitilizing agent. The crystals had an ao = 8.300A as determined by X-ray analysis. Other crystals which can be prepared electrolytically from a flux of MCl2 and MB4O7 are boron, CaB6, SrB6, BaB6, YB6, MnB, TiB2, and TaB2. Polycrystalline samples of TiSi2, ZrSi2, CrSi2, and Fe2Si can also be prepared by electrolyzing mixtures of alkali metal fluorosilicates and fluotitanates. However, these compounds have not been well-characterized. Author (TAB)

N68-12111# Aerospace Corp., El Segundo, Calif. Space Physics Lab.
FAR-INFRARED OPTICAL PROPERTIES OF PRESSED CDTE
C. M. Randall and R. D. Rawcliffe Sep. 1967 9 p refs
(Contract F04695-67-C-0158)
(TR-0158(9260-01)-1; SAMSO-TR-67-43; AD-660896)

The optical properties of a commercial pressed CdTe for frequencies between 15 and 50 wavenumbers were determined from spectra Fourier-transformed from interferograms obtained with the Aerospace lamellar grating interferometer. By use of parameters obtained in the mid-infrared and by adjustment of the value of the low-frequency dielectric constant to a best-fit value of 10.324 plus or minus 0.008, it was found that the measured refractive index and absorption agree well with the predictions of a damped Lorentz oscillator model. Author (TAB)

N68-12112# California Univ., Los Angeles. Dept. of Physics.
THE ANALYSIS OF THE POLARIZED VIBRONIC SPECTRUM OF $CsUCl_6$ AND THE ZEEMAN EFFECT OF Cs_2UCl_6 AND Cs_2UBr_6
David R. Johnston Aug. 1967 184 p refs
(Contract DA-31-124-ARO-(D)-219)
(AROD-2099.30-P; TR-5; AD-661292)

It was found that Cs2UBr6 has vibronic selection rules for the Zeeman effect which are dependent on the direction of the magnetic field. If the magnetic field is directed along the (100) direction of the crystal, distinctive Zeeman patterns result in the vibronic spectrum which, when the space group becomes known, could result in further understanding of the vibronic structure. The oscillator strengths for pure electronic magnetic dipole transitions were measured and compared with calculated values. The expected splitting of electronic levels in Cs2UCl6 was calculated using a small parameterized D3d distortion potential and a least square fit to five experimentally observed splittings. This information has led to a more complete understanding of the electronic spectrum. Author (TAB)

N68-12114 California Univ., Davis. Dept. of Applied Science.
CLOSER-PACKED ALKALI HALIDE STRUCTURES AT HIGH PRESSURE
B. J. Alder Sep. 1967 9 p refs Symp. High Dyn. Pressure, Paris, 11–15 Sep. 1967

The possible existence of additional crystal structures for the alkali halides at high pressures is demonstrated by showing that the lattice free energy of a close-packed arrangement is lower than either of the known NaCl or CsCl crystal structures. The pressure and density of such a phase transformation is shown to be within the range of available shock experiments. Author

N68-12115 National Bureau of Standards, Washington, D. C.
SHOCK WAVE PROPAGATION IN A TWO-DIMENSIONAL CRYSTALLINE LATTICE
D. H. Tsai and C. W. Beckett Sep. 1967 16 p refs Presented at Symp. High Dyn. Pressure, Paris, 11–15 Sep. 1967

Lattice dynamics has been applied to the study of the propagation of a strong, one-dimensional shock wave in a two-dimensional face-centered cubic lattice. The shock was generated at the free surface of the lattice by impact, and propagated into the lattice in the longitudinal direction perpendicular to the free surface. The transverse motion of the lattice points allowed the shock wave to be scattered and the compressive energy to be distributed between the longitudinal and transverse degrees of freedom. In our calculation, a Morse type potential function between pairs of lattice points was employed, and the interactions were assumed to extend to the fourth-neighbors. The equations of motion of the lattice points were solved by an approximate numerical method, and from the solutions, the dynamical behavior of the shock wave, the vibrational energy, and the Grüneisen parameter in the shock compressed region were obtained. These results were compared with similar results for a one-dimensional lattice model. Author

N68-12118 Atomic Weapons Research Establishment, Aldermaston (England).
A GRUNEISEN EQUATION OF STATE FOR COPPER
P. G. Parish Sep. 1967 16 p refs Presented at Symp. High Dyn. Pressure, Paris, 11–15 Sep. 1967

A method is developed for calculating Gruneisen's Γ from basic experimental data using a modified form of the Dugdale–MacDonald relation in which thermal energy is not ignored. The modification makes Γ a function of specific volume only, and thereby removes some of the ambiguity in the application of the relation. The equations which are developed are applied to the calculation of Γ and other thermodynamic parameters for copper, for a range of densities from 8.4 up to 18 gms/cc. Author

N68-12137 India. Dept. of Atomic Energy, Bombay. Bhabha Atomic Research Centre.
COHESIVE ENERGY OF ALKALI METALS
A. P. Govindan Kutty and P. G. Khubchandani 1967 53 p refs
(B.A.R.C.-293)

The electron gas model of a solid is used to calculate the cohesive energy of a metal due to electron–electron interaction; this amounts to calculating the energy of the electron gas in its ground state. The Hamiltonian for the electron gas is formulated, and the free electron approximation approach is discussed. The values obtained indicate, however, that the Coulomb interaction between the electrons cannot be ignored. The Hartree and Hartree–Fock approximations are formulated. Although improvements in cohesive energy values are noted, it is pointed out that these calculations are not suitable for properties which depend on the distribution at the Fermi surface. Also assessed, with only fair results obtained, are the perturbation approach; (2) interpolation between low and high density data on metallic densities; and (3) a collective description technique, in which the electron gas is treated as a quantum plasma, the long wavelength divergences are tied down to the zero point oscillations of plasmons, and the short wavelength contribution to the energy calculated by ordinary perturbation. M.G.J.

N68-12156# Ballistic Research Labs., Aberdeen Proving Ground, Md.
THE EFFECTS OF LASER RADIATION ON LEAD SULFIDE PHOTOCONDUCTORS Interim Report, 1 Jun.–30 Sep. 1966
Millan D. Stoller Aug. 1967 32 p refs
(BRL-TN-1665; AD-661074)

The report presents a descriptive survey of the behavior of lead sulfide photodetectors when subjected to laser radiation. It shows that a photodetector has an internal current gain due to decrease of its resistance brought about by absorption of laser radiation. The various experimental observations of changes in the internal characteristics of lead sulfide sensors are noted and interpreted. Author (TAB)

N68-12156# Groningen Rijksuniversiteit (Netherlands). Lab. for Physical Chemistry.
MOLIONIC LATTICES: THE ORGANIC SEMICONDUCTORS TMPD/CLO_4 AND TMPD/CHLORANIL Final Report, 1 Feb. 1964–31 Jan. 1967
Jan Kommandeur and Gerard T. Pott 1 May 1967 105 p refs
(Contract AF 61(052)-769)
(AFCRL-67-0554; AD-660605)

By the techniques of ultraviolet spectroscopy, electron spin resonance, X-ray diffraction, differential thermal analysis and the measurement of the electronic conductivity it was shown that the lattice of the donor-acceptor complex N-N-N'-N'-tetra-methyl-p-phenylenediamine (TMPD) Chloranil (CA) consists of molecules in a super-lattice of the bipositive and binegative ions (TMPD(++) and CA(=) of the constituting species. Similarly, the low temperature phase of Wursters Blue Perchlorate consists of alternating bipositive ions and neutral molecules of TMPD. This intimate mixing of molecules and ions explains all of the measured properties of the substances, such as their paramagnetism, their electrical conductivity and their ultraviolet and visible absorption spectra. The theoretical considerations put forward appear to offer a way of interpreting similar properties in a large number of other organic semi-conductors. Author (TAB)

N68-12164# Columbia Univ., New York. Dept. of Electrical Engineering.
ELECTRONIC PROPERTIES OF REFRACTORY MONOXIDES HAVING INTRINSIC LATTICE VACANCY CONCENTRATIONS Annual Progress Report, Jan. 1–Dec. 31, 1966
Stephen Paul Denker 1 Jan. 1967 55 p refs
(Contract AT(30-1)-3553)
(CU-3553-6) CFSTI: HC$3.00/MF$0.65

Single crystals of TiO, VO, $ScVO_2$, $ScTiO_2$ were prepared and studies were made on their electronic properties. The Hall effect was measured in Cu. The theory of bonding and stability of refractory phases is discussed at length, and NMR studies were made on VO. NSA

N68-12223 Sandia Corp., Albuquerque, N. Mex.
HALL EFFECTS MEASUREMENTS IN SHOCK-LOADED SEMICONDUCTORS
J. Kennedy Sep. 1967 19 p refs Symp. High Dyn. Pressure, Paris, 11–15 Sep. 1967 Sponsored by AEC

Successful Hall effect measurements have been performed before, during, and immediately after the passage of a plane shock wave through doped single crystal semiconductor specimens. A stress pulse having an amplitude slightly less than the Hugoniot elastic limit of the sample is produced by a low pressure explosive plane wave lens. Hall voltage measurements are made during the 5 μsec prior to shock wave entry and the 3 or 4 μsec during and immediately following shock propagation through the specimen. The sample is surrounded by carefully mated identical material which, for the duration of the experiment, ensures that the specimen

is in a state of one-dimensional strain. A uniform magnetic field of up to 30 kG is produced in the sample by means of an expendable solenoid, and the Hall current is switched on just prior to shock wave entry into the semiconductor. The behavior of doped n and p-type Si and Ge in the [100] crystallographic orientation is investigated. Author

N68-12230# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
CONSERVATION OF ANGULAR MOMENTUM FOR OPTICAL PROCESSES IN CRYSTALS
N. Bloembergen Oct. 1967 18 p refs
(Contracts Nonr-1866(16); Nonr-1866(07); Nonr-1866(32))
(TR-544; AD-661204)

The redistribution of angular momentum over atomic spin and orbitals, crystalline lattice and electromagnetic field is analyzed for a variety of linear and nonlinear optical processes in crystals. Simple classical and quantummechanical models are discussed. Special attention is paid to the magnetization of a body by light in the inverse Faraday effect and the generation of circularly polarized optical harmonics by laser light which is polarized in the opposite sense. Author (TAB)

N68-12234# Aerospace Corp., El Segundo, Calif. Electronics Research Lab.
BRIGHTNESS TEMPERATURE OF THE QUIET SUN AT CENTIMETER AND MILLIMETER WAVELENGTHS, AND CHROMOSPHERIC MODELS, AUGUST 1966–AUGUST 1967
F. I. Shimabukuro and J. M. Stacey Oct. 1967 17 p refs
(Contract F0495-67-C-0158)
(TR-0158(3230-46)-1; SAMSO-TR-67-44; AD-660897)

Brightness temperature measurements of the quiet sun are tabulated and plotted for the centimeter, millimeter, and infrared wavelengths. The measurements at centimeter and millimeter wavelengths are compared with temperatures derived from two solar models. The reported brightness temperature measurements show that a revision of chromospheric electron temperature and density estimates is needed and suggest the possibility of a temperature inversion in the chromosphere. The refinement of chromospheric models is dependent upon more accurate and higher resolution measurements at millimeter wavelengths. Author (TAB)

N68-12240# South Dakota School of Mines and Technology, Rapid City. Dept. of Physics.
THERMAL CONDUCTIVITY, SEEBECK COEFFICIENT, AND ELECTRICAL RESISTIVITY OF HEAVILY PHOSPHORUS-DOPED SILICON FROM 313°K to 673°K
Thomas H. T. Gaidry (Ph.D. Thesis) 1 Nov. 1967 58 p refs
(Contract Nonr-2964(01))
(TR-23; AD-660668)

The thermal conductivity, electrical resistivity, and Seebeck coefficient of heavily phosphorus-doped silicon were measured between 313K and 673K. The cylindrical single-crystal sample had a nominal impurity concentration of 5x10 to the 19th power donors per cu cm. The series comparison method with Armco iron as a standard was used for measuring the thermal conductivity. The relative random error of the thermal conductivity measurements was determined to be 6%. The measured values for the thermal conductivity of the heavily doped sample ranged from 0.562 W/cm K at 373K to 0.265 W/cm K at 673K. The electrical resistivity varied directly with temperature, thus indicating that the lattice scattering of the electrons was dominant in the degenerate semiconductor. The values obtained for the Seebeck coefficient passed through a minimum of -260 mu V/K at approximately 600K. The lattice thermal conductivity was computed from Hollands theory of thermal conductivity. A disorder parameter Gamma of 0.0055, which was 18 times larger than the associated theoretical value for Gamma, was needed to reach agreement between theory and experiment. An electron-phonon interaction term, which was inserted into Hollands analysis, was found to have negligible effect except near 300K where it reduced the calculated thermal conductivity by 35 mW/cm K. Author (TAB)

N68-12254 European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.
SOME ELECTRIC EFFECTS IN TERPHENYL [QUELQUES EFFETS ELECTRIQUES DANS LE TERPHENYLE]
R. Bauch, F. Diletti, M. Hoepper, and F. Van Rutten 1967 41 p refs In FRENCH
(EUR-3631.F) CFSTI: $3.00

Electrical conductivity and Seebeck effect of terphenyls were measured. The charge of particles suspended in terphenyls and the electroviscosity of such a suspension were investigated. The influence of such electric effects on fouling deposition is discussed. Author

N68-12258# California Univ., Berkeley. Electronics Research Lab.
RESEARCH ON DAMPING MECHANISMS IN FERRIMAGNETS Final Report, 1 Jul.–14 Aug. 1967
S. Wang 14 Aug. 1967 8 p refs
(Grant DA-ARO(D)-31-124-G638)
(AROD-4582-5-E; AD-661066)

During the period July 1965–August 1967, the research work under Grant DA-ARO-D-31-124-G638 consists of the following two topics: (1) Excitation of magnetoelastic-waves and (2) Interaction of spin-waves with a laser beam. Author (TAB)

N68-12268*# Delaware Univ., Newark. Dept. of Physics.
DARK CONDUCTIVITY OF CDS AS A FUNCTION OF S-VAPOR PRESSURE DURING HEAT TREATMENT BETWEEN 500°C AND 700°C
K. W. Boer [1967] 22 p refs
(Grants NsG-573; Nonr(G)-4336-00)
(NASA-CR-91050; TR-16) CFSTI: $3.00 CSCL 20L

The dark conductivity of CdS as a function of the sulfur vapor pressure is investigated during heat treatment in a temperature range $500°<T<700°C$. The pressure dependence follows $j \approx p_S^{-1/m}$ with $m=|x,I$ being the average number of sulfur atoms per molecule. For $500°<T<525°C$, $x=3$, for $525°<T<630°C$, $x=1$ and for $630°<T<700°C$, $x=1$. These results are explained by thermodynamic disorder and a Cd-rich nonstoichiometric equilibrium below 525°C. Schottky–Wagner disorder most probably is dominant above 525°C. The energy of doubly ionizing a sulfur vacancy is $E_c-E_{V_S}=0.48$ ev. Author

N68-12293# Hewlett-Packard Co., Palo Alto, Calif.
INVESTIGATION AND DEVELOPMENT OF SEMICONDUCTOR-METAL CATHODES Final Report, 16 May 1966–15 Aug. 1967
Thomas O. Yep and Robert J. Archer Aug. 1967 61 p refs
(Contract AF 19(628)-5946)
(AFCRL-67-0530; AD-660577)

A major phase in the development and characterization of rectifying metal-semiconductor contacts for application to cathodic emission was completed. A number of contacts meet the requirements of Schottky barrier heights equal to or greater than 1.5 eV and V-I slope constants (q/kT dV/d ln I near unity. Results are presented for contacts on B6P, ZnO, ZnS, GaAs1-xPx, GaP and ZnSe. Most effort was concentrated on Cu, Ag and Au contacts to GaP and ZnSe. Contacts with both etch-polished and vacuum-cleaved interfaces were studied, and (for GaP) both the influence of surface crystalline orientation and the temperature dependence of the contact properties determined. Author (TAB)

N68-12339 California Univ., Berkeley. Lawrence Radiation Lab.

RELAXATIONS IN A MOLECULAR CRYSTAL. 2: THE FERMI MOMENTUM OF ALUMINUM FROM 0 TO 100 KILOBARS

James J. Burton (Ph.D. Thesis) Apr. 1967 121 p refs
(Contract W-7405-ENG-48)
(UCRL-17479) CFSTI: HC$3.00/MF$0.65

Properties of imperfect lattices of monatomic face-centered-cubic crystals are examined theoretically. The atomic interactions are represented by pair-wise additive potentials. The effects of relaxations on the energies of the defects are examined. For bulk defects the relaxations are small and only slightly alter the energy of the defect. Vacancies in argon are bound to other vacancies or to substitutional impurities. The activation energy is calculated for self-diffusion in argon for both monovacancy (3812 cal) and divacancy (4847 cal) exchange diffusion. The activation energies for neon and krypton impurity diffusion via monovacancy exchange are 2187 and 3733 cal, respectively. The relaxations and surface energies of (100), (111), and (110) surfaces of aluminum, argon, calcium, copper, lead, nickel, and silver are calculated. The energies of adsorption of argon, krypton, and neon atoms on the (100) surface plane of argon are calculated. The Fermi momentum of aluminum is studied from 0 to 100 kilobars pressure.
Author (NSA)

N68-12344* Hughes Research Labs., Malibu, Calif.

DEVELOPMENT OF ION IMPLANTATION TECHNIQUES FOR MICROELECTRONICS

O. J. Marsh, R. G. Hunsperger, H. L. Dunlap, and J. W. Mayer Oct. 1967 84 p refs
(Contract NAS12-124)
(NASA-CR-86014) CFSTI: $3.00 CSCL 20L

Electrically active layers were produced in GaAs using zinc and cadmium ions which form p-type layers, and tellurium and indium ions which form n-type layers. Short anneal periods at temperatures of 600°C were found necessary to activate the implanted ions. Hall effect and sheet resistivity measurements established the effective number of carriers per square centimeter in the implanted layer and the effective carrier mobility. Capacitance–voltage measurements on surface barriers were used to establish implanted carrier distributions as a function of depth. It was found that damage or defects induced during implant anneal away at 600°C. The n-type regions were formed by antimony implantations in both α- and β-SiC with anneal temperatures as low as 1000°C; p-type regions were obtained by implanting aluminum ions into n-type β-SiC and annealing at 1700°C. Other experimental work indicates that hot substrate implantation in CdTe do not appear feasible.
Author

N68-12359# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics.

ANHARMONIC, THICKNESS-TWIST OVERTONES OF THICKNESS-SHEAR AND FLEXURAL VIBRATIONS OF RECTANGULAR, AT-CUT, QUARTZ PLATES

R. D. Mindlin and W. J. Spencer (Bell Telephone Labs.) June 1967 41 p refs
(Contracts Nonr-4259(13); DA-36-039-AMC-00065(E))
(ONR-TR-5; VSA-EC-ITR-4; AD-661197)

Equations of motion accommodating thickness-twist overtones of thickness-shear and flexural vibrations of rectangular, AT-cut, quartz plates are obtained. The equations are solved for plates with all four edges free. The predicted frequencies are compared with measured resonances. X-ray topographs of typical thickness-twist overtone modes are exhibited which verify that the mode shapes correspond to those predicted.
Author (TAB)

N68-12362# Pennsylvania State Univ., University Park. Dept. of Metallurgy.

TRANSFORMATIONS IN AB_2 INTERMETALLIC COMPOUNDS Progress Report, Mar. 1, 1966–Feb. 28, 1967

Earle Ryba 1 Mar. 1967 24 p refs
(Contract AT(30-1)-3560)
(NYO-3560-7) CFSTI: HC$3.00/MF$0.65

Developments in studies on phase transformations, crystallography, electronic properties, and mechanical properties of type-AB_2 intermetallic compounds are reported. A large number of runs on several $HoZn_2$ samples revealed that the X-ray diffraction pattern changed when the sample was heated. However, no phase transition occurred in this compound over the range room temperature to 900°C. Thermal expansion data for $HoZn_2$ are given. Lattice parameters for $NdZn_2$, $GdZn_2$, and $TbZn_2$ are tabulated. Data on the magnetic susceptibilities and microhardness of a number of $REZn_2$ (RE = rare earth) compounds are also given.
NSA

N68-12378# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics.

THEORIES OF ELASTIC CONTINUA AND CRYSTAL LATTICE THEORIES

R. D. Mindlin Aug. 1967 16 p refs
(Contract Nonr-4259(13))
(TR-6; AD-661201)

This paper is concerned with the relations between lattice and continuum theories of the elastic behavior of perfect crystals. In the case of a simple bravais lattice, it is shown in what way the differential equations of motion of successively higher order 'strain gradient' theories of elasticity correspond to successively shorter-wave approximations to the difference equations of motion of the lattice and how the additional material constants, which appear in the gradient theories, are related to the force constants of the lattice. In the case of a lattice with a basis, a new theory of elasticity is given for the long wave approximation. As distinguished from the long wave, low frequency approximation, it is also shown how to obtain shorter-wave continuum approximations to the equations of motion of a lattice with a basis. Finally, for both types of lattice, it is shown how the difference equations of motion may be converted to differential equations which yield the same dispersion relations, as do the difference equations, for all wave lengths.
Author (TAB)

N68-12396# New York Univ., N. Y.

ELECTRONIC STRUCTURE OF ORGANIC MOLECULES AND ORGANIC SEMICONDUCTORS Final Report, 12 Feb. 1964–30 Jun. 1967

Jules W. Moskowitz 30 Jun. 1967 16 p refs
(Contract AF 19(628)-4040)
(AFCRL-67-0517; AD-661280)

Accurate self-consistent-field functions were computed for several small polyatomic molecules, including benzene, in a basis of Gaussian functions. All multicenter molecular integrals were calculated and the core electrons explicitly included. This work represents the first step in the theoretical study of the electronic structure of molecular crystals.
Author (TAB)

N68-12399 California Univ., Livermore. Lawrence Radiation Lab.

SHOCK-INDUCED DEMAGNETIZATION OF NICKEL FERRITE, YTTRIUM IRON GARNET, AND IRON

E. B. Royce 1967 15 p refs Presented at the Symp. on High Dyn. Pressure, Paris, 11–15 Sep. 1967

The demagnetization of samples of nickel ferrite, yttrium iron garnet, and iron on shock compression has been measured as a function of pressure and biasing field. In low-field experiments,

the shock-induced reduction in magnetic flux through the sample was detected by pickup coils wound on ferrite bars completing the magnetic circuit between the sample and biasing permanent magnet. In high-field experiments, a pulsed solenoid was used to bias the sample. The magnetization was always biased in a direction transverse to the shock-propagation direction, and only the change in the transverse component was measured. For the ferrimagnetic ceramics nickel ferrite and yttrium iron garnet, the change in magnetization is due to the combined effects of (1) the shift in Néel temperature with compression and the temperature rise associated with shock compression, and (2) a shock-induced longitudinal magnetic anisotropy associated with the shock-induced anisotropic microscopic strain. This anisotropy originates from the non-zero yield strength of the material and results in the shock propagation direction becoming an easy direction of magnetization. Author

N68-12413# Los Alamos Scientific Lab., N. Mex.
ANOMOLOUS SUPERCONDUCTING PROPERTIES OF REFRACTORY CARBIDES AND NITRIDES OF GROUP 4A AND 5A ELEMENTS
A. L. Giorgi, E. G. Szklarz, and T. C. Wallace [1966] 19 p refs Presented at the British Ceram. Soc. Meeting, London
(Contract W-7405-ENG-36)
(LA-DC-8022; CONF-661207-1) CFSTI: HC $3.00/MF $0.65

The variation of the superconducting transition temperature (T_c) of the fcc (NaCl-type) form of NbC, TaC, HfN, and (Hf,Zr)N solid solution was studied as a function of the composition over the homogeneity range of the various compounds. In all cases T_c was found to vary sharply with stoichiometry. For NbC and TaC, changes in T_c ranged from a condition of no superconducting transition for measurements down to 1.05°K for the lowest C content, to T_c values of 9.7°K for $TaC_{.987}$ and 11.1°K for $NbC_{.977}$. An opposite behavior was observed in the HfN system. The highest T_c, 8.7°K, was obtained for the lower stoichiometry and no superconducting transition was found above 2.0°K for the composition $HfN_{1.12}$. The transition temperature for the (Hf,Zr)N solid solution series increased smoothly as the composition became richer in Zr and reached its maximum value of 10.7°K for $ZrN_{.948}$. When T_c was plotted as a function of the lattice parameter, the resulting curves were similar for all materials studied. T_c increased smoothly with increasing lattice parameter. Author (NSA)

N68-12439 Ecole Nationale Superieure de Mechanique et d'Aerotechnique, Poitiers (France). Faculte des Sciences.
ELECTRONIC EFFECTS RELATED TO PASSAGE OF SHOCK WAVES IN METAL JOINTS [EFFETS ELECTRIQUES LIES AU PASSAGE D'UNE ONDE DE CHOC DANS DES JONCTIONS METALLIQUES]
A. Migault and J. Jacquesson 15 Sep. 1967 8 p refs In FRENCH Presented at High Dyn. Pressure, Paris, 11–15 Sep. 1967
CFSTI: $3.00

A theoretical interpretation is presented on the initiation of a shock wave in an electric field and its relation to the network distortion caused by the shock. The calculated results are compared with the experimental results for pressures to 80 to 300 kb. Transl. by M.G.J.

N68-12445# Yale Univ., New Haven, Conn.
THE STUDY OF ALLOY SURFACES BY LOW ENERGY ELECTRON DIFFRACTION Technical Summary Report, 1 Oct. 1966–30 Sep. 1967
W. D. Robertson 26 Oct. 1967 17 p
(Contract N00014-67-0097-0003)
(TSR-1; AD-660719)

An investigation was made for developing capability in low energy electron diffraction (LEED): (1) to determine the detailed structure of crystal surfaces, (2) to identify impurities on the surface, in particular of nominally very pure gold, (3) to remove impurities from the surface, and (4) to design apparatus which will contribute to the development of scattering theory from low energy electrons and at the same time provide quantitative measurement of adsorption parameters at low temperatures. Author (TAB)

N68-12450# Delaware Univ., Newark. Physics Dept.
STATIONARY HIGH FIELD DOMAINS IN THE RANGE OF NEGATIVE DIFFERENTIAL CONDUCTIVITY IN CdS SINGLE CRYSTALS
Karl W. Boer and Peter Voss Oct. 1967 29 p refs
(Grant Nonr(G)-4336-00)
(TR-21; AD-661192)

In CdS crystals with an N-shaped negative differential conductivity range stationary high field domains adjacent to the electrodes are observed. With increasing applied voltage these steplike domains increase in width staying attached to the cathode until they fill the entire crystal, then a still higher field domain is formed at the anode and increases in width. These domains can be explained within an earlier published theory and allow the determination of electron densities at the cathode-CdS boundary, and in the field quenched region. The analysis of these stationary domains presents a new tool for work function (metal semiconductor) investigations. Author (TAB)

N68-12462 Direction des Etudes et Fabrications d'Armement, Gramat (France).
ELECTRONIC UNBALANCE CREATED BY A SHOCK WAVE IN A METAL-APPLICATION TO THE IRREGULAR THERMOELECTRIC EFFECT [DESEQUILIBRE ELECTRONIQUE CREE PAR UNE ONDE DE CHOC DANS UN METAL APPLICATION A L'EFFET THERMOELECTRIQUE ANORMAL]
H. Conze, J. Crosnier, and C. Berard 15 Sep. 1967 6 p refs In FRENCH Presented at High Dyn. Pressure, Paris, 11–15 Sep. 1967
CFSTI: $3.00

Evidence is presented to show the strong electron perturbations caused by a shock wave in the crystal state of a solid due to the emission of phonons. Equations are derived to calculate the difference of potential, the electron temperature, the temperature of the material, the distribution function of phonons in a shock wave, and the electron movement in a shock wave. Transl. by M.G.J.

N68-12493# Atomics International, Canoga Park, Calif.
VORTEX STRUCTURE IN SUPERCONDUCTING FILMS IN A PARALLEL FIELD
I. O. Kulik 1967 10 p refs Transl. into ENGLISH from Zh. Eksperim. Teor. Fiz. (Moscow), v. 52, no. 6, Jun. 1967 p 1632–1637 In RUSSIAN
(AI-TRANS-258)

It is shown that in a certain range of thickness (exceeding the coherence radius $\xi(T) \approx \hbar v_0/\Delta(T)$, but less than the penetration depth $\delta(T)$) a one-dimensional vortex structure of current and magnetic field being parallel to the surface). The possibility of observing such a structure by means of optical diffraction is discussed. Author (NSA)

N68-12576# Northrop Corp., Hawthorne, Calif
TRANSIENT CONDUCTIVITY IN ORGANIC INSULATORS Final Report, Jun. 1966–Jun. 1967
John W. Winslow Sep. 1967 119 p refs
(Contract AF 19(628)-6047)
(NCL-67-35R; AFCRL-67-0515; AD-660820)

A technique for measuring quasi-dc photoconductance in amorphous polymers during steady-state irradiation was developed.

This technique, which involves control of the samples history prior to making measurements, was applied to 21 polyethylene and 14 polystyrene samples, during exposure to Co60 gamma fields with intensities up to 200000 r/hr. Conductances observed using this technique were inversely proportional to sample thickness, thus permitting calculation of the bulk, quasi-dc photoconductivities. Analyses of the data from the observations indicate the following: that both these materials are essentially ohmic, at least up to applied electric fields on the order of 10% of breakdown; that trace impurities do not play important roles in the conduction mechanisms involved in either material; that structural defects may play such a role, but if they do, they are present in very large concentrations in polyethylene at least so large they are considered essential structural features; and that in both materials, dependence on radiation intensity is weaker than reported. TAB

N68-12577# Argonne National Lab., Ill.
SPECIFIC HEAT AND MAGNETIC SUSCEPTIBILITY OF SOLID SOLUTIONS OF YTTRIUM CONTAINING SMALL AMOUNTS OF GADOLINIUM [CHALEUR SPECIFIQUE ET SUSCEPTIBILITE MAGNETIQUE DES SOLUTIONS SOLIDES DILUEES D'YTTRIUM–GADOLINIUM]
Y. Allain, J. Bonnerot, B. Caroli, B. Coqblin, R. Jesser et al Aug. 1967 25 p refs Transl. into ENGLISH from J. Phys. (Paris), v. 28, 1967 p 98–106
(ANL-TRANS-513) CFSTI: HC$3.00/MF$0.65

Measurements of the specific heat and the magnetic susceptibility of yttrium solid solutions with magnetic impurities of gadolinium are reported. The indirect interaction model of Ruderman–Kittel between ionic spins of gadolinium atoms can qualitatively explain the observed cooperative effects. Moreover, an f virtual bound-state model with spin and orbital decoupling is suggested to try to account for the apparently high values taken by the electronic term of the specific heat and by the magnetic moment. Author (NSA)

N68-12588# Gosudarstvennyi Komitet Po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Atomnoi Energii.
CURRENT STABILITY CRITERIA IN COMPOSITE NORMAL+SUPERCONDUCTING CONDUCTORS
V. E. Keilin, E. Yu. Klimenko, M. G. Kremlev, and B. N. Samoilov Dec. 1966 11 p refs Transl. into ENGLISH from IAE-1208 Rept.
(IAE-1208; NP-TR-1511) CFSTI: HC$3.00/MF$0.65

For the purpose of a quantitative estimate of the reversibility criteria of the transition of superconducting solenoids to the normal state, a simplified model is considered, namely, an infinite conductor (normal metal, in thermal and electrical contact with the superconductor) with a point heat source. The conditions for stability of the current in such a conductor are deduced. Author (NSA)

N68-12590# Duke Univ., Durham, N. C. Dept. of Electrical Engineering.
SUPERCONDUCTING CIRCUITRY Progress Report
Charles R. Vail Jun. 1967 27 p refs
(Contract AT(40-1)-2430)
(ORO-2430-40) CFSTI: HC$3.00/MF$0.65

In the development of optimum materials for thin film devices for use in computer circuitry, surface, magnetic, dielectric, and strain effects; deposition techniques; and properties of films detached from substrates were studied. The conductivity surface characteristics, and electric properties of thin gold films were determined. Grain and surface structure data for nickel films deposited by electron bombardment on glass substrate were evaluated. Nickel and permalloy pure films were deposited by evaporation. X-ray diffraction was used to study strain distribution in thin gold films. Capacitors using a bismuth oxide insulating layer with thin gold films evaporated on them are discussed. NSA

N68-12651# Los Alamos Scientific Lab., N. Mex.
MAGNETIC PROPERTIES OF $PrAl_2$
C. E. Olsen, G. Arnold, and N. Nereson [1967] 6 p refs Transl. into ENGLISH from J. Appl. Phys., v. 38, 1 Mar. 1967 p 1395–1396
(Contract W-7405-ENG-36)
(LA-DC-8136; CONF-661107-2) CFSTI: HC$3.00/MF$0.65

Neutron-diffraction powder patterns have confirmed that the compound $PrAl_2$ undergoes a magnetic transition to a ferromagnetic structure at a Curie temperature of 38°K. The ordered moment at saturation on the Pr atom sites is $2.94 \pm 0.05\ \mu_B$, which is close to the full moment of $3.2\ \mu_B$ expected for the free Pr^{+3} ion. No detectable moment is observed for Al. The present results for the total moment per molecule are in satisfactory agreement with previous magnetization measurements. The shape of the magnetic form factor for the Pr^{3+} ion was determined over the range from $(\sin\theta)/\lambda = 0.1$ to $0.5\ \text{Å}^{-1}$ and is in good agreement with calculated values. Author (NSA)

N68-12702# University of Southern Calif., Los Angeles. Dept. of Electrical Engineering.
A STUDY OF MAGNETIC, THERMAL, AND TRANSPORT CURRENT PHENOMENA IN TYPE 2 SUPERCONDUCTORS Summary Progress Report, 1966
M. A. R. Le Blanc Dec. 1966 17 p refs
(Contract AT(11-1)-113)
(USC-113P16-3) CFSTI: HC$3.00/MF$0.65

The conduction current in wires of type-II superconductors was found to flow in paramagnetic helical paths in the presence of axial magnetic fields. An alternating current in wires of type-II superconductors in the presence of a static axial magnetic field was observed to give rise to a longitudinal magnetization whose amplitude varies at twice the frequency of the alternating current. Magnetization currents induced by the removal of an axial magnetic field enabled considerably enhanced conduction currents to flow in the wire before a critical threshold was attained. Alternatively, the presence of a conduction current in the wire immersed in an axial magnetic field was seen to lead to appreciably amplified magnetization currents when the magnetic field was reduced. Author (NSA)

N68-12703# California Univ., Berkeley. Lawrence Radiation Lab.
ANALYSIS FOR YTTRIUM WITH A SEMICONDUCTOR X-RAY EMISSION SPECTROGRAPH AND AN I^{125} SOURCE
Jack F. Klecka 3 Oct. 1966 18 p
(Contract W-7405-ENG-48)
(UCRL-17144(Rev.)) CFSTI: HC$3.00/MF$0.65

Yttrium solutions mounted either on Mylar film strips or ion exchanged loaded paper were placed in a sample holder and the X-rays excited in Y by an I^{125} source were measured by a semiconductor for a period of time ranging from 10 to 30 min depending upon the sample size. In the case of 1 μg samples considerably larger count periods were used. The results of the two different types of sample preparation (Mylar film and ion exchanged loaded paper) were compared. Calibration curves and background were very similar. The results obtained were found to be similar to those obtained previously by others. NSA

N68-12727# Argonne National Lab., Ill.
EXISTENCE AND STRUCTURE OF RARE-EARTH MONOCARBIDES: STUDY OF THEIR MAGNETIC PROPERTIES AT LOW TEMPERATURES [EXISTENCE ET STRUCTURE DES MONOCARBURES DE TERRES RARES, ETUDE DE LEURS PROPRIETES MAGNETIQUES A BASSES TEMPERATURES]

Robert Lallement (Ph.D. Thesis—Paris Univ., Orsay (France)). Sep. 1967 90 p refs Transl. into ENGLISH from French Report CEA-R-3043
(ANL-TRANS-517; CEA-R-3043) CFSTI: HC $3.00/MF $0.65

There are two types of rare earth carbides, the first one is fcc, stable at high temperature, and very hypostoichiometric (formula MC_x with $0.36<x<0.65$); the other is rhombohedric, stable at lower temperature, with a formula M_2C. These two carbides are magnetically ordered at low temperatures (ferro or ferri-magnetism). They are highly anisotropic. A great part of the electric and magnetic properties can be explained from the following ideas: the M^{3+} ions are coupled via the conduction electrons, there are more conduction electrons in the carbides than in the metals, and there is some local order around the transition temperatures. Author (NSA)

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N68-11940# Dayton Univ., Ohio. Research Inst.
PHYSICAL AND CHEMICAL PROPERTIES OF JP-4 JET FUEL FOR 1966 Annual Report, 1 May 1966–1 Jun. 1967
William E. Brockman and Donovan S. Duvall Sep. 1967 132 p
(Contract AF 33(615)-2692)
(UDRI-TR-67-139; AFAPL-TR-67-108; AD-660957)

The report is a compilation of suppliers inspection data on JP-4 jet fuel purchased by the Air Force during 1966. A statistical study was made of twenty standard specifications tests. All tests showed a skew distribution. No particular problems were noted in meeting any of the specification limits. A four year summary of selected specifications tests is presented. Author (TAB)

N68-12210# Naval Weapons Center, China Lake, Calif.
AN INVESTIGATION OF THE EFFECT OF ENVIRONMENTAL GASES AND PRESSURE ON THE IGNITION OF SOLID ROCKET PROPELLANTS
J. D. Hightower (M.S. Thesis—Calif. Univ., Los Angeles) Oct. 1967 106 p refs
(NWC-TP-4431; AD-661243)

An investigation was made of the effect of environmental gases and pressures on the ignition of an ammonium perchlorate propellant. In addition, ignition studies were conducted on the individual propellants ingredients. The results indicate that the major exothermic reaction responsible for rapid convergence to steady state deflagration occurs in the gas phase immediately adjacent to the propellant surface. The shortest ignition times were obtained with oxygen as the environmental gas. The ignition times of both propellant and inert formulation were the same in this environment. Ignition times of the propellant in nitrogen were longer than in oxygen but approximately the same as the ignition time of pressed pellets in methane. The ignition times of the propellant in inert atmosphere was found to increase with decreasing molecular weight of the environmental gas. At the higher flux densities the ignition time was found to be dependent on the environmental pressure with ignition times increasing with decreasing pressure. These results are discussed in terms of a simple ignition model with (a) no chemical heating, (b) chemical heating in the condensed phase and (c) chemical heating in the gas phase. TAB

N68-12315*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SOLID PROPELLANT ENGINEERING
In its Space Programs Sum. No. 37-47, Vol. 3 31 Oct. 1967 p 69–84 refs (See N68-12306 03-30)

Engineering research studies in the following areas are reported: solid propulsion binder investigatiogs; propellant binders terminated by acid chloride groups; Application Technology Satellite motor development; and oxidizer particle size effects in dual oxidizer high slope solid propellant formulations. Included are investigations of polyesters of dimer acid, partial hydrogenation of unsaturated hydroxy-terminated telagens, infrared studies of saturethane curing, preparation of trifunctional alcohol, and the development of a model curing system. C.T.C.

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magneto-hydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N68-12180*# Douglas Aircraft Co., Inc., Huntington Beach, Calif. Missile and Space Systems Div.
COMPARATIVE STUDY OF THRUST-VECTOR-CONTROL SYSTEMS FOR LARGE, SOLID-FUELED LAUNCH VEHICLES. VOLUME 1: SUMMARY
G. D. Budris Nov. 1967 30 p
(Contract NAS1-7109)
(NASA-CR-66504; DAC-58065) CFSTI: HC $3.00/MF $0.65
CSCL 21H

This is a comparative analysis of several advanced thrust vector control (TVC) system designs applied to a large, solid-fueled launch vehicle. The TVC systems evaluated were the Lockheed Lockseal omniaxial flexible nozzle, the Thiokol buried nozzle pintle modulated chamber gas secondary injection system, and the Vickers continuous flow auxiliary warm gas generator secondary injection system. A brief review was also made of Allegany Ballistics Laboratory chamber bleed in line pintle valve system in the cyclic on–off and fully modulating modes. A previously contracted Phase II Head-End Steering Study was used to provide design criteria such as the mission, launch vehicle, natural environment, vehicle geometry and aerodynamic uncertainness, maneuvering requirements, steering analysis, and provided some comparison with other TVC systems and the effects of fins. Included in the comparative analyses were the effects of control response, launch vehicle stability, interchangeables of TVC on the stages, ground operations, allowable flight path divergence, and reliability. Author

N68-12193* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ELECTRIC PROPULSION: SYSTEMS, FLIGHT MECHANICS, POWER SOURCE, AND MISSION APPLICATIONS
Ernst Stuhlinger *In* AGARD Nucl., Thermal and Elec. Rocket Propulsion 1967 p 540–625 refs (See N68-12184 03-22) CSCL 21C

Electric propulsion systems are classified as electrothermal, electrostatic, electrodynamic, and photonic, and the characteristic features of each are described. The flight mechanics of low acceleration vehicles are discussed, and equations are formulated for determining constant exhaust velocity and variable exhaust velocity. Rocket motion in a central gravity field is analyzed, and an optimized Mars trajectory is computed. The feasibility of the ion engine concept is discussed. Electric space power sources are

assessed with consideration given to solar power supplies, nuclear reactors as prime sources, thermionic converters, plasma dynamic converters, and thermodynamic converters, along with the problems posed by the need for a radiation cooler and meteoroid hazards. The use of electric propulsion is suggested for near-earth missions, space probes, and lunar and interplanetary vehicles. M.G.J.

N68-12262# Naval Ordnance Lab., White Oak, Md.
HIGH PRESSURE CHAMBER DESIGN
Victor C. D. Dawson and Arnold E. Seigel 1 Aug. 1967 22 p refs
(NOLTR-67-121; AD-661225)

The pressure containment capability of a monobloc cylindrical chamber that remains elastic is limited by the mechanical strength of the chamber material to values of about 100,000 pounds per square inch. Higher pressures can be contained by using a shrink-fit construction or autofrettage and these techniques provide approximately twice the pressure containment capability that can be obtained with the monobloc construction. This report describes and analyzes a segmented chamber that greatly extends the high pressure capability of a cylindrical chamber in the elastic range. TAB

N68-12317*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PROPULSION RESEARCH AND ADVANCED CONCEPTS
In its Space Programs Sum. No. 37-47, Vol. 3 31 Oct. 1967 p 103–148 refs (See N68-12306 03-30)

Propulsion and advanced concepts research are reported in the following areas: experimental velocity and temperature distributions in the boundary layer of a 14,300°R subsonic gas stream; interpretation of temperature as determined from spectroscopic measurements made along a diameter of an argon plasma; an apparatus for studying heat transfer from partially ionized gases in a transverse magnetic field and initial results obtained with argon; nuclear-electric mission analysis; liquid magneto-hydrodynamic power conversion; flow visualization studies of electrical discharges between concentric electrodes; and an experimental investigation of breakdown potential in the presence of a dynamic gas in the discharge region. C.T.C.

N68-12318*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LIQUID PROPULSION
In its Space Programs Sum. No. 37-47, Vol. 3 31 Oct. 1967 p 149–168 refs (See N68-12306 03-30)

Injector hydraulics, sterilizable liquid propulsion system development, and spacecraft attitude control gas system analyses are reported in studies related to liquid propulsion. In the hydraulics area a series of experiments were conducted to demonstrate the significance of stream misalignment on the properties of the resulting spray. The approach used was to correlate the misalignment of a pair of impinging streams with the degradation of the mixing uniformity parameter. In the sterilization studies emphasis is placed on a demonstration program for hydrazine monopropellant. This demonstration showed that the monopropellant system could be subjected to thermal cycling associated with the current Voyager sterilization requirements. In the attitude control gas systems study a summary is presented of work conducted on the following systems: stored cold-gas nitrogen, vaporizing liquid plenum (ammonia), and hydrazine catalytic plenum (warm gas). Included are reports of leak testing correlations for a probe coupled with a helium mass spectrometer; and the development of a Teflon–aluminum laminate bladder and the associated helium leak tests. C.T.C.

N68-12382* Douglas Aircraft Co., Inc., Huntington Beach, Calif. Missile and Space Systems Div.
COMPARATIVE STUDY OF THRUST-VECTOR-CONTROL SYSTEMS FOR LARGE, SOLID-FUELED LAUNCH VEHICLES. VOLUME 2: TECHNICAL REPORT
G. D. Budris Nov. 1967 171 p refs
(Contract NAS1-7109)
(NASA-CR-66505; DAC-58066) CFSTI: $3.00 CSCL 21H

Design criteria and performance data for advanced thrust vector control (TVC) system designs are compared analytically and applied to large, solid fuel launch vehicles. The mission, natural and induced environments, basic launch vehicle, and TVC system concepts provide the basic design criteria. Six launch vehicle configurations were established in order to perform stability and control analyses on the four TVC systems considered, as well as to show the structural and/or configurational differences that exist because of the use of each TVC system and two payload shapes. The gimballed nozzle design centers about actuator and power system sizing and electronics necessary to perform TVC. The primary factor considered in the gas injection TVC design is the determination of the injector location. An independent roll control system was considered the prime method and applied to all vehicle configurations regardless of the TVC system used. Each TVC design was evaluated from a launch operations viewpoint to identify major advantages or disadvantages in the system design. E.J.S.

N68-12865 Aeronautical Research Council (Gt. Brit.)
THE EFFECTS OF BASE BLEED ON PLUG NOZZLES
J. Reid 1967 50 p refs Supersedes RAE-TR-65043; ARC-27137
(ARC-R&M-3466; RAE-TR-65043; ARC-27137) CFSTI: HC $3.00

This is an experimental comparison of two axi-symmetric, isentropic plug nozzles. In one, the afterbody is cylindrical and a secondary flow is bled into the annular base. The other has a parabolic afterbody with no base or bleed. In both cases the expansion is all-external and the design pressure ratio is 14. These models were tested over a range of primary and secondary flows at M_∞=0, 0.9 and 2.0. In the case of Model No. 1 measurements include the primary and secondary flow rates, the base pressure and the plug pressure distribution. The overall thrust was determined by a balance and analysed into its components; namely, the nozzle thrust and the drag of the bleed system. With Model No. 2 only the primary flow rate and overall thrust were measured. Both nozzles are efficient at the cruising condition (M_∞=2.0) and both are exceptionally flexible with regard to off-design operation (M_∞=0.9 and 0). However, at M_∞=0.9 and 2.0, the overall thrust of Model No. 1 using optimum bleed is slightly less than that of Model No. 2. Author

#68-12802# Frankford Arsenal, Philadelphia, Pa. Pitman-Dunn Research Labs.
EVALUATION OF HIGH PERFORMANCE ROCKET MOTORS USING SUBSCALE PRECRACKED CASES
Carl M. Carman Aug. 1967 31 p refs
(FA-R-1863; AD-660335)

The Army Materiel Command recently completed a program directed toward developing improved techniques for the fabrication of high performance solid propellant rocket motors. As a result of this study, cases fabricated by ARDE-Portland Inc. and The Budd Company were available for test. The solid propellant rocket motors fabricated by ARDE-Portland Inc. were made by cryogenically stretch-forming 301 stainless steel; The Budd Company developed a helically wrapped and welded case using cold rolled and aged 250 grade maraging steel. Plane strain fracture toughness values were determined for the cryogenically stretch-formed 301 stainless steel and the cold rolled and aged 250 grade maraging steel. These values were used to calculate the size of the defect to be introduced in the case wall. A semicircular crack 0.030 in. long by 0.015 in. deep was recommended for the maraging steel case and a semicircular crack 0.050 in. long by 0.025 in. deep was recommended for the ARDE-Portland case. These cracks were introduced into the case wall and the cases were hydrotested at -65 F. The data show that, as predicted by fracture mechanics, the case strength was not degraded by the presence of these small defects. Author (TAB)

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N68-12061# RAND Corp., Santa Monica, Calif.
THE VERTICAL STRUCTURE OF DYNAMO WINDS DEDUCED FROM GEOMAGNETIC VARIATIONS ASSOCIATED WITH SOLAR FLARES
Stanley M. Greenfield and S. V. Venkateswaran (Calif. Univ., Los Angeles) Oct. 1967 30 p refs Presented at the Birkeland Symp. on Aurora and Magnetic Storms, Sandefjord, Norway
(P-3690; AD-660552)

At 1522 UT on August 28, 1966 there occurred a massive solar flare of estimated importance 3B. This flare produced significant disturbances on the magnetograms obtained from some 36 stations distributed throughout the sunlit hemisphere. Much of the major structure observed on these magnetograms occurred with significant simultaneity and correlated well with observed SID events. A detailed time analysis of these records was attempted and equivalent ionospheric current systems calculated for several times beginning with the observed start of the flare. The analysis is consistent with a spectral history of a flare in which the X-ray radiation becomes progressively harder as the flare advances toward maximum. The analysis indicates the existence of vertical variation in the global wind systems in the dynamo region, resulting in a reversal of current in the upper portion of this region. It suggests that the time analysis of SFE represents a new tool for examining the vertical structure of the winds in this region. TAB

N68-12089# Aerospace Corp., El Segundo, Calif. Space Physics Lab.
RECENT RESULTS OF INNER ZONE PARTICLE FLUXES
S. C. Freden, J. B. Blake and G. A. Paulikas Sep. 1967 27 p refs
(Contract F04695-67-C-0158)
(TR-0158(3260-20)-1; SAMSO-TR-67-46; AD-660911)

Some recent data, calculations, interpretations of inner zone proton fluxes and spectra and their time variations are presented. Sources and losses are discussed. Recent measurements of inner zone electron fluxes and spectra are also given and comparisons are made with pre-Starfish and earlier post-Starfish data. Decay lifetimes for the Starfish electrons are shown. Author (TAB)

N68-12160# IIT Research Inst., Chicago, Ill.
EARTH'S PARTICLES AND FIELDS Final Report, 31 Jul.–11 Aug. 1967
W. O. Davies, Billy M. McCormac, and Robert Sears Sep. 1967 29 p Presented at the NATO Advanced Study Inst., Freising, Germany
(Contracts DAAD05-67-C-0573; Nonr(G)-00025-67)
(AD-661316)

Contents: Introduction; Energetic charged particles; Low-energy charged particles; Diffusion, acceleration and loss of charged particles; Electric and magnetic fields, and wave-particle interactions; Solar wind magnetosphere interactions; Conclusions. TAB

N68-12340# California Univ., Livermore. Lawrence Radiation Lab.
A LIGHTWEIGHT, 1-METER-DIAMETER, 11 KG, SUPERCONDUCTING MAGNET SYSTEM FOR A BALLOON-CARRIED COSMIC RAY EXPERIMENT
Clyde E. Taylor, Robert L. Nelson, Carl D. Henning, Alfred R. Taylor, and Arthur Harvy 15 Sep. 1967 15 p refs Presented at the 2nd Intern. Conf. on Magnet Technol., Oxford, 11–14 Jul. 1967
(Contract W-7405-ENG-48)
(UCRL-70285, Rev. 1; CONF-670705-1) CFSTI: HC $3.00/MF $0.65

A very lightweight magnet system, with large aperture and with magnetic field normal to the particle path, is being built. The main features of this system are: central field, 11 kG; configuration, saddle-shaped split coils; free access diameter, 1.0 meter; conductor, 19-strand cable with three 0.51-mm-diameter strands of Nb–Ti; current, 870 amperes; Dewar exterior dimensions, 1.0-M i. d. × 1.60 M o. d. × 2.46 M long; weight of coil and Dewar, 1630 kg; stored energy, 1.2×10^6 J. This report describes the main features of this coil system including field configuration, structural problems, and construction details. Author (NSA)

N68-12864# Naval Research Lab., Washington, D. C. E. O. Hulburt Center for Space Research.
SOME RESULTS OF TWENTY YEARS OF EXTREME ULTRAVIOLET SOLAR RESEARCH
Richard Tousey 1966 81 p refs Presented at the 122d Meeting of the Am. Astron. Soc., Ithaca, N. Y., 26 Jul. 1966 Submitted for publication

An overview is presented of solar research in the extreme ultraviolet during the past two decades. Numerous illustrations depict findings by various researchers, and a list of references is appended. M.W.R.

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N68-11952*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NIMBUS 1 HIGH RESOLUTION RADIATION DATA CATALOG AND USER'S MANUAL VOLUME 2: NIMBUS METEOROLOGICAL RADIATION TAPES—HRIR
15 Jul. 1966 88 p refs
(NASA-TM-X-60720) CFSTI: $3.00 CSCL 22B

The Nimbus I Meteorological Satellite contained a High Resolution Infrared Radiometer (HRIR) designed to map nighttime cloud cover and measure surface temperatures from radiation emitted within the 3.5 to 4.1 micron atmospheric window. HRIR data were acquired from a near polar orbit during the period from August 28, 1964 to September 22, 1964, after which a spacecraft malfunction occurred and no usable data were obtained from the sensory subsystems. This volume contains a discussion of the spacecraft performance, the HRIR subsystem, data acquisition and processing, and documentation of the available data. Author

N68-11956*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
A GRAPHICAL COSTING PROCEDURE FOR ADVANCED MANNED SPACECRAFT (MASCOT G)
H. C. Mandell Oct. 1967 62 p refs
(NASA-TM-X-58012) CFSTI: HC $3.00/MF $0.65 CSCL 14A

The method presented is based on a series of log–log graphs of reference cost data points, allowing cost comparisons to be made in three parametric dimensions: absolute cost, subsystem size (weight), and subsystem complexity (cost per pound). Both nonrecurring and item costs are presented. Techniques are presented

to build module and total project-level costs from the sums of subsystem-level costs. These techniques are a series of ratios between corresponding levels of historical program-level, module-level, and subsystem-level costs. An example problem is presented to illustrate the use of the historical data for estimating the costs of an advanced module. The Apollo lunar module was chosen so that results could be compared with actual program data. Author

N68-11987# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.

A PROBABILISTIC APPROACH TO SEARCH STRATEGY FOR MARS EXPLORATION LANDERS

Robert Preston and K. M. Foreman Oct. 1967 17 p refs
(RM-380)

This memorandum is an introduction to the application of search theory for allocating landing sites for planetary exploration landers. The mathematics of a simplified probabilistic approach are presented and applied to a hypothetical sample problem of life detection at two vastly different potential Martian landing regions. It is shown that for a particular level of search effort, a higher mission success probability can be obtained by allocating at least one lander to a region where there is small likelihood of the mission objective being achieved successfully, than by exclusively persisting in landings at an area considered a priori as prime for the existence of life. Author

N68-12013# Defense Research Telecommunications Establishment, Ottawa (Ontario). Electronics Lab.

THE APPLICATION OF HAMILTONIAN MECHANICS TO SATELLITE DYNAMICS

V. J. Modi Oct. 1967 133 p refs
(DRTE-1188) CFSTI: HC $3.00/MF $0.65

The basic concepts behind the Hamiltonian mechanics method of mathematical formulation and solution of a dynamical system are examined in terms of Newton's law, Euler's equations, holonomic and nonholonomic systems, and Lagrange's equation. Their applications in solving librational stability problems of an earth orbiting satellite are indicated. The basic problems of an earth orbiting satellite are indicated. The basic principles upon which the Hamiltonian formulation is founded are considered: D'Alember's principle, the principle of virtual work, and the variational principle. Hamilton's canonical equations are derived, and the properties of a Hamiltonian are defined. The importance of the Hamiltonian approach is proved by an illustrative example. The concept of phase space and its usefulness in studying response and stability of a dynamical system is discussed. It is shown how the contact transformation leaves Hamilton's canonical equations invariant and introduces an arbitrary or generating function. An example of a spring mass system illustrates the application of the Hamilton–Jacobi method to determining the response of a single degree of freedom configuration. M.G.J.

N68-12044*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE NIMBUS 2 DATA CATALOG, VOLUME 3, 1 AUGUST THROUGH 31 AUGUST 1966 (ORBITS 1035-1447)

Sep. 1966 251 p Prepared by Allied Res. Assoc., Inc.
(NASA-TM-X-60719) CFSTI: $3.00 CSCL 22A

The Nimbus 2 monthly catalogs present the type of data available, geographic location, time of the data, and continuity of the various data. This volume contains the daily sensor "ON" status charts for the Advanced Vidicon Camera System and the High Resolution Infrared Radiometer; operation data of the Automatic Picture Transmission subsystem and the Direct Readout Infrared Radiometer; data on orbital elements, ascending, and descending nodes; and data produced by the Sensory Information Processing program. A data extraction is provided to facilitate search and retrieval by subject, yielding certain types of peripheral information required to support further analysis. K.W.

N68-12048# Bonn Univ. (West Germany). Astronomical Inst.

INVESTIGATIONS OF THE PROPER MOTIONS OF THE OPEN CLUSTERS IC 4996 AND NGC 2301 AND OB-STARS NEAR P CYGNI [UNTERSUCHUNGEN UEBER DIE EIGENBEWEGUNGEN VON STERNHAUFEN XIII: IC 4996, NGC 2301 UND OB-STERNE UM P CYGNI]

Heinrich van Schewick et al 1967 38 p refs In GERMAN; ENGLISH summary
(Rept.-76) CFSTI: HC $3.00/MF $0.65

The relative and absolute proper motions of the open cluster IC 4996 are given. The material consists of three pairs of plates taken with the 5 m refractor of Bonn Observatory with epoch differences of 40 to 43 years. The cluster members are separated from the field stars. The results are compared with photometric investigations. The cluster IC 4996 contains no yellow giants, and the number of photometrically determined main sequence stars has been reduced. The relative and absolute proper motions of OB-stars in the neighborhood of P Cygni and proper motions of stars of the Kapteyn Selected Area 98 containing the open cluster NGC 2301, as determined from measurements of Groningen and Bonn are also given. Again, the number of photometrically determined main sequence stars has been reduced. The cluster NGC 2301 contains no yellow giants. Author

N68-12054# Paris Observatory, Meudon (France).

FINDINGS ON PLANETARY SURFACES AND ATMOSPHERES FROM A STUDY OF THE PHOTOGRAPHIC COLLECTIONS OF THE I.A.U. PLANETARY DATA CENTER AT MEUDON Final Scientific Report

A. Dollfus Jul. 1967 100 p refs
(Contract AF 61(052)-873)
(AFCRL-67-0504; AD-660598)

To facilitate researches on collections of photographic plates on planets, previously scattered in several observatories, the Committee International Cooperation for the Observations of Planets of the International Astronomical Union established in 1961 two Planetary Data Centers, at Lowell Observatory, USA and at Meudon Observatory, France. Several thousands of plates of all the planets are now available at these Centers. The Committee coordinated also new photographic observations of planets between stations at several longitudes on the Earth, for the studying rapid changes on planetary atmospheres and surface features. The present report summarize the new findings on planets Mercury, Venus and Mars, and on satellites systems, obtained by the analysis during the past three years of the documents available at the Meudon Data Center. Author (TAB)

N68-12087*# California Univ., Berkeley. Space Sciences Lab.

THE PRESENT DAY VIEW OF THE PHYSICAL UNIVERSE

Harold F. Weaver *In its* Ann. Conf. of Episcopal Cathedral Deans Apr. 1967 p 79–101 (See N68-12081 03-34)

Basic data are presented on the position of the earth and the planets, and the properties, motions, and characteristics of the stars and the galaxies they form. Comparisons are drawn between the observations obtained by optical astronomy and the different views obtained in the radio range. It is pointed out that different physical processes produce radiations of different characteristic wavelengths, and that a large portion of the electromagnetic spectrum must be used to see the universe in all its complexity. M.G.J.

N68-12131 Office National d'Etudes et de Recherches Aerospatiale, Paris (France).
SYNTHESIS OF THE ANALYTICAL RESULTS ON OPTIMAL TRANSFERS BETWEEN KEPLERIAN ORBITS [SYNTHESE DES RESULTATS ANALYTIQUES SUR LES TRANSFERTS OPTIMAUX ENTRE ORBITES KEPLERIENNES]
Christian Marchal, Jean-Pierre Marec, and C. B. Winn (Colo. State Univ.) 1967 36 p refs In FRENCH; ENGLISH summary Presented at the 18th Intern. Astronautic Congr., Belgrade, 25–29 Sep. 1967
(ONERA-TP-515(1967)) CFSTI: $3.00

Studies of optimal transfers and rendezvous are surveyed. The propulsion systems are classified into two main categories: high thrust systems or those with an imposed exhaust velocity, and low thrust systems or those with an imposed exhaust power. The optimization theories are classified in turn into time-free and time-fixed cases. Studies of the time-free case for high thrust systems indicate that finite thrusts are more expensive than impulses for orbital transfer. Investigations of close and distant orbits in the time-fixed case are also reviewed. Singular arcs are found to be easily integrated in the planar case but not in the three dimensional case. N.E.N.

N68-12136*# National Aeronautics and Space Administration, Washington, D. C.
NASA SPECIAL PUBLICATIONS CURRENTLY AVAILABLE, FALL 1967
1967 49 p refs
CFSTI: HC $3.00/MF $0.65 CSCL 22A

Capsule information is presented on the contents of the various publications which reflect the manifold activities of NASA. Advances in engineering, technology, and management are described, along with discoveries and innovations of NASA research centers, contractors, and subcontractors that may have potential industrial applications. Space flight data and significant acievements in space science are documented. Proceedings of conferences and symposia of specialists in many different academic disciples are offered. The publications are grouped according to general series; handbooks, data compilations, charts, and tables; histories and chronologies; the technology utilization series; management, evaluation, and analysis standards; and bibliographies and other reference works. Title and subject indexes are included. Instructions for ordering and price of each are given. M.G.J.

N68-12174# Liege Univ. (Belgium).
HIGH RESOLUTION SPECTRA OF THE SUN
Luc Delbouille and Ginette Roland 31 Aug. 1967 28 p refs
(Contract AF 61(052)-955)
(SR-4; AD-661252)

The University of Liege is operating, since 1958, a laboratory of solar spectroscopy at the International Scientific Station of the Jungfraujoch (Switzerland). During the last years, much effort has been devoted in two main directions: (a) techniques of correction for the effects of the instrumental function to obtain the best possible knowledge of central intensities and profiles of photospheric lines. (b) increase of the signal to noise ratio in the records in order to detect and measure very faint absorption features. In addition, a balloon-borne equipment is now under construction in Liege to observe, with maximum resolution, the near infrared solar spectrum from an altitude of about 80,000 feet. Author (TAB)

N68-12216* Boeing Co., Seattle, Wash.
LUNAR ORBITER 2: POSTMISSION PHOTO SUPPORTING DATA
26 Sep. 1967 531 p
(Contract NAS1-3800)
(NASA-CR-66478; D2-100752-7) CFSTI: $3.00 CSCL 22A

The supporting data required for evaluating the Lunar Orbiter Mission 2 photographs are described in detail. The types and sources of input data required by the photographic evaluation computer program (Eval) are categorized as (1) state vectors—spacecraft position and velocity at a reference time; (2) attitude maneuvers executed from a known attitude reference, either celestial or nonstandard cruise; (3) photo times; (4) planetary constants; and (5) spacecraft constraints. The error sources which degrade the Eval data are identified as state vector, spacecraft attitude, camera pointing, camera-on time, and computational noise. Definitions of the quantities output by Eval are included. A listing is presented of the values of constants contained within the link to the user program. These constants include spacecraft and planetary constants used by Eval. M.G.J.

N68-12227# MITRE Corp., Bedford, Mass.
A PRIORITY MODEL FOR FLIGHT OPERATIONS PLANNING
Lee Suyemoto Sep. 1967 55 p refs
(Contract AF 19(628)-5165)
(MTR-256; ESD-TR-67-391; AD-661274)

The concept of priority is used in many contexts and in many fields. A priority model for priority problems arising in diverse contexts and fields is established. The application of the concept of priority is made principally with respect to Flight Operations Planning (FOP) of a manned spacecraft. Author (TAB)

N68-12306*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37-47, VOLUME 3 FOR THE PERIOD AUGUST 1, 1967 TO SEPTEMBER 30, 1967. SUPPORTING RESEARCH AND ADVANCED DEVELOPMENT
31 Oct. 1967 304 p refs
(Contract NAS7-100)
(NASA-CR-91047; JPL-SPS-37-47, V. 3) CSCL 22

An overview is presented on the research projects being conducted in the areas of systems analysis, project engineering, guidance and control, applied mechanics, environmental simulation, propulsion, space sciences, and telecommunications. For individual titles, see N68-12307 through N68-12328.

N68-12307*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SYSTEMS ANALYSIS RESEARCH
In its Space Programs Sum. No. 37-47, Vol. 3 31 Oct. 1967 p 1–7 refs (See N68-12306 03-30)

An investigation is made of the effect of infrared spectrometer (IRS) gas jetting on the Mariner Mars 1969 celestial mechanics experiment. The investigation was conducted as an extension of an earlier study in which it was concluded that if the random component in the translational force from the jetting could be held to less than ±1 dyne, then the solution for the astronomical constants of interest would not be affected by the jetting. Differing assumptions in these two investigations are tabulated, and it is noted that the main advantage of the current analysis is that the IRS jetting is included as a systematic error source in the computed covariance matrix for the constants and is allowed to act in three orthogonal directions. The most significant result is that unknown forces as high as 100 dynes can be tolerated in certain directions, for example in the elliptic plane normal to the sun–spacecraft direction; but unknown forces of 100 dynes in a direction normal to the elliptic completely invalidate results obtained with data taken during the IRS jetting period. C.T.C.

N68-12308*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMPUTATION AND ANALYSIS
In its Space Programs Sum. No. 37-47, Vol. 3 31 Oct. 1967 p 8–20 refs (See N68-12306 03-30)

Consideration is given to the numerical integration of the lunar ephemeris, and to numerical differentiation and interpolation of JPL ephemeris DE19. Results of a numerical integration and least-squares fit to the lunar ephemerides LE2 and LE4 using PLOD II are described. The numerical method used in the ephemeris reading routines is discussed, and error bounds are derived for the differentiation and interpolation formulas. C.T.C.

N68-12309*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
FLIGHT OPERATIONS AND DSN PROGRAMMING
In its Space Programs Sum. No. 37-47, Vol. 3 31 Oct. 1967 p 21-29 refs (See N68-12306 03-30)

A computer program for the determination of some coefficients of the moon's gravity potential expansion is described. The basic theory used in solving the problem is discussed, and the structure of the resultant program which implements this theory is detailed. The discussion is based on Lunar Orbiter tracking data, with consideration given to such areas as data fitting and compression, generation of long-arc trajectories, and long-arc fitting. C.T.C.

N68-12313*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
APPLIED MECHANICS
In its Space Programs Sum. No. 37-47, Vol. 3 31 Oct. 1967 p 47-53 refs (See N68-12306 03-30)

The state and motion variables, and the convective and radiative heat transfer distributions are determined about two blunt bodies (sphere cone and sphere cap) entering into a Martian atmosphere. The calculations were performed for two free stream conditions: (1) hyperbolic entry at a point near maximum stagnation, convective and radiative heat transfer, and (2) ballistic range case at conditions for which experimental radiation data have been obtained. It is noted that results of the studies may be used to interpret the more approximate results of a set of computer programs for preliminary entry vehicle design studies; to assess the results of measurements of the total radiative heat transfer; and to determine possible scaling procedures for extrapolating the model results obtained in a simulated atmosphere to full scale flight conditions. C.T.C.

N68-12321*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LUNAR AND PLANETARY SCIENCES
In its Space Programs Sum. No. 37-47, Vol. 3 31 Oct. 1967 p 184-187 refs (See N68-12306 03-30)

Consideration is given to studies of (1) lunar surface composition and particle size; implications from laboratory and lunar spectral reflectance data and (2) reflection losses in White cells and the detection of weak absorption lines. In the first area a description is given of a model that poses the possibility that many of the albedo and color differences on the moon may be controlled by differences in mean particle size on the lunar surface. This hypothesis is discussed in terms of studies on the spectral reflectance properties of rock powders. In the second area consideration is given to a method for observing weak spectroscopic absorption lines in gases. Spherical mirrors are used to cause the light to pass through the sample many times before entering the analyzing spectrometer. When the absorption line is particularly weak, a very large number of passes may be used so that a significant fraction of the light will be absorbed. Some of the factors that place a practical upper limit on the maximum number of useful reflections are enumerated, and a criterion for optimum operation is suggested. C.T.C.

N68-12328*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
FUTURE PROJECTS
In its Space Programs Sum. No. 37-47, Vol. 3 31 Oct. 1967 p 279-281 (See N68-12306 03-30)

A lunar ice experiment in which a flask of plain water was suddenly released into a moderate (30-μ) vacuum is discussed. A sequence of selected frames from a 48-f/s motion picture record is included. Future experiments to be conducted relative to the lunar ice hypothesis are also discussed. C.T.C.

N68-12354 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
SOME GENERAL PROPERTIES IN THE DOMAIN OF MANEUVERABILITY AT THE SEMILINEAR BOUNDARY APPLIED TO ORBIT TRANSFERS [QUELQUES PROPRIETES GENERALES DES DOMAINES DE MANOEUVRABILITE A FRONTIERE SEMI-LINEAIRE. APPLICATION AUX TRANSFERTS D'ORBITE]
Pierre Contensou 1967 27 p refs In FRENCH Presented at the Colloq. on Probl. and Methods Proposed for the Optimization of Space Flights, Liege, 19-23 Jun. 1967
(ONERA-TP-518(1967) CFSTI: $3.00

Optimization of orbit transfers is discussed for linear systems in which the maneuverability domain at the boundary is semilinear. Means for determining the accessible domain are considered, as are the properties of systems with maneuverability domains that are strictly convex. Optimal trajectories are discussed, along with conditions for optimality; and the Pontryagin maximum principle is shown to be a necessary condition for optimality. Applications for the optimization of spatial trajectories are discussed, with specific attention to orbit transfer. Transl. by M.W.R.

N68-12433# California Univ., Livermore. Lawrence Radiation Lab.
EDDY TRANSPORT MAINTENANCE OF SOLAR DIFFERENTIAL ROTATION
George Herman Nickel (Ph.D. Thesis) 1 Sep. 1967 42 p refs
(Contract W-7405-ENG-48)
(UCRL-50224) CFSTI: HC $3.00/MF $0.65

The differential rotation of the sun is interpreted as the largest axisymmetric mode of two-dimensional surface turbulence which is symmetric under reflection through the equatorial plane. The amplitude of this mode is determined by a balance of energy transport into the mode from smaller modes and energy dissipation by eddy viscosity. These smaller modes could be either photospheric turbulence or larger scale motions due to a horizontal instability which could arise if the solar equator were slightly warmer than the poles. Energy transport to large modes from small modes is a property of two-dimensional turbulence; an estimate is made for the maximum radial velocity of large scale motions in the convective zone for which the model is valid. A computer model of the nonlinear interaction of these two-dimensional modes verifies that energy can be transported to the differential rotation mode, and that the correlation of zonal and meridional velocities is in qualitative agreement with results obtained from sunspot observations. Author (NSA)

N68-12474# Stanford Univ., Calif. Inst. for Plasma Research.
RADIATION PRESSURE ON A CONDUCTING SPHERE
R. Burn and O. Buneman Oct. 1968 11 p refs
(Contract AF 49(638)-1524)
(SUIPR-112; AFOSR-67-2325; AD-659445)

The radiation pressure on a conducting sphere was found to have a sharp peak of 2.6 times the geometrical cross section at a wavelength of five times the sphere radius. In the limit of zero wavelength the effective cross section approaches the geometrical cross section asymptotically, while for wavelengths longer than 20 radii the cross-section becomes negligible. Author (TAB)

N68-12585# Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.
A THEORY OF DUST COMETS

Michael L. Finson and Ronald F. Probstein Aug. 1967 175 p refs
(Contract Nonr-184(93))
(Publ.-67-4; AD-660652)

A model based on kinetic and fluid dynamic concepts is formulated for the head and tail regions of dust comets. In the model, dust particles having a wide distribution of sizes are released from the comet nucleus in an essentially continuous manner in time during the period of distinctive cometary phenomena due to solar heating. The dust particles are accelerated radially outward from the nucleus by drag forces due to the expanding comet head gas. After leaving this region, the only significant forces assumed to act on the dust particles are the solar gravity and the solar radiation pressure. Observed nonradial dust tail orientations are explainable by this model. Calculated surface density distributions are compared with measured light intensity distributions for Comet Arend-Roland, from which the distribution of dust particle sizes, the dust and head gas emission rates as functions of time, and the emission velocity from the inner head region as a function of particle size and time, are determined essentially for the first time. Dust particle diameters on the order of 1 micron and a size distribution similar to those obtained for interplanetary dust are found. For Comet Arend-Roland, near its perihelion, high dust and gas emission rates are found, confirming previous estimates. An outburst in the dust emission is deduced to have occurred in Comet Arend-Roland about six days before perihelion. It is suggested that dust-rich comets emit larger amounts of dust during their approach to the sun than during recession. Author (TAB)

N68-12678# Advisory Group for Aerospace Research and Development, Paris (France).
TECHNICAL SUPPLEMENT TO AGARD INFORMATION BULLETIN 67/3
Nov. 1967 76 p refs Presented at the AGARD Ann. Meeting, Turin, Italy, Sep. 1967
(AGARD-557) CFSTI: $3.00

Italian space research and development activities connected with the ELDO and ESRO International European Programs, and with joint USA ventures, are reported. The organization of scientific research and technology in Italy (July, 1967) under the various governmental ministries and under National Research Council (CNR) committees, is described. Scientific work progress from activities of the SACLANT Antisubmarine Warfare Research Center of NATO, are also reported. L.S.

N68-12715# Advisory Group for Aerospace Research and Development, Paris (France).
BY-PRODUCTS OF SPACE RESEARCH AND DEVELOPMENT
Raymond L. Bisplinghoff (MIT) Sep. 1966 23 p refs Presented at the Advisory Group for Aerospace Res. and Develop. Meeting, Delft (Netherlands), 2 Sep. 1966
(AGARD-544; AD-661166)

The report emphasises the importance of the by-products of space research as reflected in the fields of scientific education, and in general scientific and engineering research and development. Specific examples are given. Author (TAB)

N68-12769 Osservatorio Astronomico di Roma (Italy).
ANNUAL REPORT [RAPPORTO ANNUALE]
Massimo Cimino 1967 88 p refs In ITALIAN
(AR-1)

The annual report of the Astronomical Observatory at Rome covers administrative organization and overall facilities as well as scientific activities. Equipment, the library, and publications of the observatory are discussed. Transl. by M.W.R.

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N68-11919*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FLIGHT TEST OF A 40-FOOT-NOMINAL-DIAMETER MODIFIED RINGSAIL PARACHUTE DEPLOYED AT A MACH NUMBER OF 1.64 AND A DYNAMIC PRESSURE OF 9.1 POUNDS PER SQUARE FOOT
Clinton V. Eckstrom, Harold N. Murrow, and John S. Preisser Washington Dec. 1967 28 p refs
(NASA-TM-X-1484) CFSTI: HC$3.00/MF$0.65 CSCL 22B

A ringsail parachute, modified to provide a total geometric porosity of 15 percent of the reference area, was flight tested. The payload for the flight test was an instrumented capsule from which the test parachute was ejected by a deployment mortar when the system was at a Mach number of 1.64 and a dynamic pressure of 9.1 pounds per square foot. The parachute deployed to suspension line stretch in 0.45 second with a resulting snatch force of 1620 pounds. Canopy inflation began 0.07 second later and the parachute projected area increased slowly to a maximum of 20 percent of that expected for full inflation. Because the parachute never reached the full-open condition, the large drag force normally associated with parachute inflation did not develop. The difference in rotation between the spinning payload and the deployed canopy has normally resulted in some twisting of the payload attachment bridle and riser system. The suspension lines also twisted, primarily because the partially inflated canopy could not restrict the twisting to the attachment bridle and risers. This twisting of the suspension lines hampered canopy inflation at a time when velocity and dynamic-pressure conditions were more favorable. It is concluded that the most probable cause of the failure of the parachute to inflate properly was excessive total porosity (geometric open area and cloth permeability) in the crown area of the canopy. Author

N68-11934*# Republic Aviation Div., Fairchild Hiller Corp., Farmingdale, N. Y.
MANUFACTURING FEASIBILITY STUDY OF ADVANCED TANKAGE FOR RECOVERABLE BOOSTERS Final Report
15 Nov. 1967 106 p
(Contract NAS8-21108)
(NASA-CR-91077; FHR-3524) CFSTI: $3.00 CSCL 22D

A multicell recoverable first stage rocket booster of the 3,000,000 lb thrust class can be integrated in a booster system capable of placing a 60,000 lb payload into a 100 N. Mi. orbit. The skin temperatures over the first stage booster surfaces, are low enough to permit the use of unprotected aluminum alloy as the basic tank material. Satisfactory reentry trajectories starting from M=4.8 at 168,000 ft can be achieved ballistically with speed brakes extended or at high lift with speed brakes retracted. The study was based on the use of modified Saturn IB launch facilities. The basic materials and manufacturing technology developed in the Saturn IB program can be utilized to great advantage in this program. Some manufacturing development programs will be required to demonstrate the overall manufacturing feasibility of the multicell recoverable first stage rocket booster. Author

N68-11961*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FLIGHT TEST OF A 15-FOOT-DIAMETER (4.6-METER) 120° CONICAL SPACECRAFT SIMULATING PARACHUTE DEPLOYMENT IN A MARS ATMOSPHERE

Wayne L. Darnell, Allen B. Henning, and Reginald R. Lundstrom
Washington Dec. 1967 76 p refs
(NASA-TN-D-4266) CFSTI: HC $3.00/MF $0.65 CSCL 22B

An experiment was conducted in Earth atmosphere which simulated the deployment of an 85.3-foot-diameter (26.0-meter) ringsail parachute behind a spacecraft entering a Mars Atmosphere when at an altitude of about 18,000 feet (5.5 kilometers). The spacecraft was a 120° cone having a base diameter of 15 feet (4.6 meters) and weighing 1687 pounds (765 kilograms). It was carried to an altitude of 130,300 feet (39.7 kilometers) above the Earth by a 26,000,000-ft^3 (736240-m^3) balloon. After release from the balloon over the White Sands Missile Range, rockets propelled the spacecraft to a Mach number of 1.19 and a dynamic pressure of 6.4 lbf/ft^2 (306 N/m^2). The parachute was deployed by a parachute mortar. Onboard instrumentation consisted of motion picture cameras and a tape recorder which recorded the output from accelerometers and temperature sensors. Good data were obtained from all instrumentation. The parachute, which was deployed in a reefed condition, did not have sufficient drag to withdraw the instrumented payload from the spacecraft until it was disreefed. Temperatures measured at critical points in the spacecraft were within the desired operating range. Author

N68-11977*# Thiokol Chemical Corp., Ogden, Utah. Astro-Met Div.
A STUDY TO GUIDE RESEARCH AND DEVELOPMENT TOWARD AN OPERATIONAL METEOROLOGICAL SOUNDING ROCKET SYSTEM Final Report, Oct. 1966–Apr. 1967
R. Gail Billings and R. Frank Atmore Apr. 1967 83 p refs
(Contract NASw-1522)
(NASA-CR-91057) CFSTI: HC $3.00/MF $0.65 CSCL 16D

This report describes a study conducted to derive a set of guidelines for research and development toward an operational meteorological rocket system. Emphasis is placed on the rocket vehicle. The desirable attributes of a meteorological rocket vehicle are based on functional, operational, and economic considerations. These attributes are enumerated and a state-of-the-art survey is included to determine their achievability. Existing classes of rocket vehicles are discussed together with gun probes, which compete economically in certain altitude regions. Current rocket-vehicle improvement attempts are also discussed. The conclusions of the study are stated in the form of recommended criteria for the design of a meteorological rocket vehicle. Author

N68-12024*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LAUNCH VEHICLE SYSTEM REQUIREMENTS AND RESTRAINTS FOR THE NIMBUS C PROJECT
Mar. 1964 74 p Revised
(NASA-TM-X-60722; NIM57-D) CFSTI: HC $3.00/MF $0.65 CSCL 22B

This document defines the technical requirements and restraints imposed by the Nimbus C spacecraft and spacecraft adapter upon the booster, booster adapter, Agena B vehicle, shroud, associated AGE, launch complex, and range. The purpose of this document is to set forth the technical requirements necessary to accomplish Nimbus project objectives, to effect formal scheduling and reporting of launch vehicle system engineering support, and to effect technical coordination between the various agencies involved in carrying out the Nimbus C program. The mission objective of the Nimbus program is to demonstrate spacecraft development and techniques for global atmospheric observations useful for meteorological research, weather forecasting, and for rapid transmission of the collected data. The Nimbus contributes further by providing basic data leading to a better understanding of atmospheric phenomena. Author

N68-12073# Aerospace Corp., El Segundo, Calif.
AUTOMATIC MAGNETIC ATTITUDE CONTROL FOR A WHEELBARROW SPACECRAFT
P. R. Dahl and E. Foxman Sep. 1967 28 p refs
(Contract F04695-67-C-0158)
(TR-0158(3113-03)-1; SAMSO-TR-67-30; AD-660536)

An on-board automatic magnetic attitude control system is devised for a spacecraft. This control system is momentum-stiffened by means of a wheel with its spin axis oriented along the spacecraft pitch axis, which nominally coincides with the orbit normal. A roll coil mounted on the despun or barrow section of the spacecraft is used in conjunction with the horizon sensor, despin motor and electronics. Its purpose is to provide roll and yaw spin axis pointing control with a very simple proportional control law, but without need for a magnetometer in the control law. A wheel speed control loop employing a yaw coil and requiring a magnetometer is included in the report. System equations, block diagram and response characteristics are presented. Author (TAB)

N68-12129 Defence Research Telecommunications Establishment, Ottawa (Ontario). Electronics Lab.
THE ALOUETTE II TOPSIDE IONOSPHERIC SOUNDER
C. A. Franklin and M. A. Maclean Nov. 1967 17 p ref
(DRTE-1189) CFSTI: $3.00

This report describes the swept-frequency pulsed sounder in the Alouette II satellite. Following a general description of the system design, attention is concentrated on some of the more difficult problems involved in its realization. Chief among these are the problems of obtaining enough transmitter power, of building a receiver with a large dynamic range, and of connecting transmitter and receiver to a common antenna. Also described are the techniques and practices used to achieve a very long life in orbit. Author

N68-12171 Radio and Space Research Station, Slough (England).
CATALOGUE OF DATA RECEIVED BETWEEN 1 JANUARY 1967–30 JUNE 1967
30 Jun. 1967 31 p
CFSTI: $3.00

Tabulated information is presented on meteorological rocket launchings by several countries and worldwide positional observations of satellites during the period from January to June 1967. R.N.A.

N68-12311*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACECRAFT CONTROL
In its Space Programs Sum. No. 37–47, Vol. 3 31 Oct. 1967 p 37–43 refs (See N68-12306 03-30)

An attempt is made to evaluate the effects on cruise limit cycle activity of an asymmetric attitude control jet configuration. Advantages of such a system are (1) translational forces due to jet leakage and impulse variations are effectively cancelled, and (2) nongravitational forces in the plane perpendicular to the probe-sun line should become negligible, placing the net forces on the spacecraft in a known direction and thus considerably improving the navigational process. It is concluded that the pitch axis receives the major effect of center of mass offsets, particularly the potentially large offset along the roll axis. At worst, pitch jet gas consumption should be expected to double, with slight increases possible in yaw and roll of about 1%. For a Mariner Mars 1969 configuration, this would result in an overall worst case gas weight increase of 25% (no disturbance torque). C.T.C.

N68-12416# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
THEORETICAL DISPERSION ANALYSIS OF THE AEROBEE 350

Edward M. D'Arcy Aug. 1967 71 p refs
(ECOM-5143; AD-661237)

The report presents a theoretical dispersion analysis of Aerobee 350. Changes in impact due to errors in drag, lift, center of pressure, restoring force moment, thrust, center of gravity, moment of inertia, mass, and wind speed for payloads of 150 and 500 pounds were tabulated. Unit wind effects for 1, 5, 10, and 20 mph winds are tabulated with ballistic factor. Peak altitude range, Coriolis effect, and time of flight are plotted as functions of payload and quadrant elevation. Nominal conditions are also presented for payloads of 150, 325, and 500 pounds. Author (TAB)

N68-12686# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
MAIN CHARACTERISTICS OF THE O.N.E.R.A. SOUNDING-ROCKETS [CARACTERISTIQUES PRINCIPALES DES FUSEES-SONDES O.N.E.R.A.]
C. Delisle 1967 37 p refs In FRENCH; ENGLISH summary
(ONERA-TN-118(1967)) CFSTI: $3.00

Characteristics, performance, and limitations are reviewed for the Tacite, Titus I, Titus II, Tibere, Crapel, and Lex sounding rockets. Use of an automatically stabilized first stage in the Titus I and Tacite rockets reduced trajectory dispersion to a large extent. Both of these are solid stage rockets; the former has two stages, while the latter has only the one. A simple calculation is given for determining effect on performance of drag variation due to different nose-cone shape. The Tibere and Lex sounding rockets are still under development; the Tibere is a three-stage vehicle with a mass excluding nose cone of 4520 kg, while the Lex is one-stage and weighs 71.4 kg. The Titus II and Crapel are both two-stage rockets. Transl. by M.W.R.

N68-12680*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
NIMBUS C FIRST ORBIT FLIGHT EVALUATION REPORT
F. Morgan, Jr. 26 May 1966 19 p
(NASA-CR-91138; Rept.-66SD4375) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Data obtained during the first orbit of the Nimbus C satellite launched on May 1966, are presented. The data show that the power subsystem and power supplies of the various subsystems that were turned on, functioned normally through the early flight phase. The values of pressurized components remained constant. The spacecraft's PCM beacon signal was satisfactorily acquired by the Ulaska tracking station. Following separation from the Agena at the planned pitch attitude, the control subsystem maintained attitude of the spacecraft within the fine limit cycle deadband, 3.8, 3.8, and 7 minutes respectively in pitch, roll, and yaw. L.S.

N68-12695 Royal Aircraft Establishment, Farnborough (England).
COSMOS SATELLITES IN ORBIT ABOUT THE EARTH [KOSMOSY NA OKOLOZEMNYKH ORBITAKH]
Yu Zaitsev Mar. 1967 7 p Transl. into ENGLISH from Aviats. i Kosmonavt. (Moscow), no. 11, 1966 p 18-24
(RAE-LIB-TRANS-1221) CFSTI: $3.00

Seven illustrations depict various aspects of Cosmos satellites, including modification of the basic satellite with chemical sources of power. This same satellite is shown with equipment for studying the upper atmosphere, and solar radiation and micrometeoritic erosion of the optical elements. A satellite for use in investigating the earth's magnetic field is illustrated, along with modifications with solar batteries and a molecular generator. Other photographs show satellites for low energy particle investigations and ionosphere studies. M.W.R.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N68-11910 Technische Hochschule Hannover (West Germany).
DIFFERENTIAL SYSTEM AND TRANSFER MATRIXES OF THE BENDING THEORY FOR GENERAL ROTATING SHELLS [DIFFERENTIALSYSTEM UND UEBERTRAGUNGSMATRIZEN DER BIEGETHEORIE ALLGEMEINER ROTATIONSSCHALEN]
Walter Wunderlich (Ph.D. Thesis) 2 May 1966 145 p refs In GERMAN *Its* No. 4
CFSTI: HC $3.00

The principles of the linear bending theory for thin shells are briefly reviewed, and the tensor formulation of the differential system for the bending theory of the rotating shells in terms of randomly selected main curvature coordinates. The integration of a linear system of ordinary differential equations of the first order with variable coefficients is accomplished by use of matrixes. Application of the method is demonstrated by calculating the various forms of a partial toroidal shell loaded at the rim by sinusoidally applied peripheral moments. Transl. by K.W.

N68-11926*# North American Aviation, Inc., Downey, Calif. Space Div.
STUDY OF APOLLO WATER IMPACT Final Report
J. P. D. Wilkinson May 1967 155 p
(Contract NAS9-4552)
(NASA-CR-65860; SID-67-498, V. 5) CFSTI: HC $3.00/MF $0.65 CSCL 20M

This volume is a user's manual for a computer program which determines the dynamic response of a shell of revolution during a vertical axially symmetric impact into an incompressible fluid. The program uses the theory developed in Volume 2 of this report where no interaction between the fluid and the flexible shell is accounted for. The hydrodynamic pressures are determined on the basis of a rigid-body theory, and are applied to the shell as a forcing function. The results are intended for comparison with similar calculations derived from Volume 3 and the user's manual of Volume 6 where the hydroelastic interaction is accounted for. Author

N68-11939*# North American Aviation, Inc., Downey, Calif. Space Div.
STUDY OF APOLLO WATER IMPACT. VOLUME 11: USER'S MANUAL FOR UNSYMMETRIC SHELL OF REVOLUTION ANALYSIS Final Report
E. Carrion, S. C. Furuike, and T. Nishimoto May 1967 320 p refs
(Contract NAS9-4552)
(NASA-CR-65863; SID-67-498, V. 11) CFSTI: $3.00 CSCL 20K

The analytical basis for the two computer programs, static and dynamic, is presented. The analysis is restricted to linear-elastic thin shell theory. The basic equations include the effect of shear distortion. The analysis utilizes a Fourier series technique to separate the circumferential variation. The resulting set of equations are reduced to an algebraic set by the use of finite different forms for variations of the other variables. These algebraic equations are then solved numerically by a direct matrix elimination procedure. The computer programs were written in FORTRAN IV. In order to keep input data at a minimum extensive use of call function subroutines have been used. Solutions obtained from the dynamic unsymmetric shell program are the displacement and rotation time histories. Also included in the output are the histories of

internal forces and moments. The solutions obtained from the static unsymmetric shell program include displacements, rotations, internal force and moment resultants, and stresses. This output is presented in tabular form. Author

N68-11950# National Center for Atmospheric Research, Boulder, Colo.

BALLOON SHAPES AND STRESSES BELOW THE DESIGN ALTITUDE

Justin H. Smalley Dec. 1966 27 p refs Sponsored by NSF
(NCAR-TN-25; PB-174099)

Shapes and stresses for ascending balloons were calculated. It was assumed that the balloon material was symmetrically deployed about the vertical axis, and the balloons had zero pressure at the bottom apex when at design altitude. Starting with design data for four fully tailored and two cylinder natural-shape balloons with all the payload at the bottom apex (considered design extremes), the shape, stresses, zero-pressure level and top pressure were determined at ten altitudes below the design altitudes. Gore position and radius at the zero-pressure level were given as approximate values. Changes due to style of design were quite small so that a single curve would suffice for many purposes. Author

N68-11954# California Univ., Berkeley. Coll. of Engineering.

A STUDY OF THE DYNAMIC STABILITY OF CONTINUOUS ELASTIC SYSTEMS BY LIAPUNOV'S DIRECT METHOD

R. H. Plaut May 1967 137 p refs
(Grant NSF GK-781)
(AM-67-3; PB-174799) CFSTI: HC $3.00/MF $0.65

The systems considered are continuous and autonomous, and include columns, arches, plates, and shallow shells. Some nonlinear and nonconservative problems are treated. One-dimensional systems are considered first. The dynamic stability of columns with various end conditions under axial loading is examined. Then necessary and sufficient stability conditions are found for a simply-supported arch and a clamped arch under distributed static loads. The nonconservative problem of a curved panel in an airstream also is investigated and a sufficient condition for stability is established. Two-dimensional systems are studied next. Stability criteria are derived for rectangular, simply-supported plates and curved panels. Author

N68-11967*# North Carolina State Coll., Raleigh.

MODAL DENSITY OF THIN CIRCULAR CYLINDERS

David K. Miller and Franklin D. Hart Washington NASA Dec. 1967 66 p refs
(Grant NGR-34-002-035)
(NASA-CR-897) CFSTI: HC $3.00/MF $0.65 CSCL 20M

A combined analytical and experimental study is made of the modal density of a thin cylindrical shell. Previous analytical work is discussed and an integral form solution is presented and evaluated numerically. Having cognizance of the experimental results, it is concluded that the integral form solution gives an accurate method for computing the cumulative number of resonant modes and the modal density of a thin cylindrical shell. Author

N68-12042# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.

AN EXPERIMENTAL STUDY OF THE EFFECT OF LENGTH ON THE BUCKLE PATTERN OF AXIALLY COMPRESSED CIRCULAR CYLINDRICAL SHELLS

R. L. Sendelbeck, R. L. Carlson, and N. J. Hoff Jun. 1967 20 p refs
(Contract AF 49(638)1276)
(SUDAAR-318; AFOSR-67-1981; AD-660585)

Ten thin-walled circular cylindrical shells were tested in axial compression to observe the effect of the length-to-radius ratio on the buckling pattern. At an approximate value of 600 of the radius to thickness ratio the number of waves around the circumference was found, in a first approximation, to very inversely with the cube root of the length-to-radius ratio. Author (TAB)

N68-12052*# North American Aviation, Inc., Downey, Calif. Space Div.

STUDY OF APOLLO WATER IMPACT. VOLUME 10: USER'S MANUAL FOR MODIFICATION OF SHELL OF REVOLUTION ANALYSIS Final Report

A. P. Cappell and S. C. Furuike May 1967 312 p
(Contract NAS9-4552)
(NASA-CR-65862; SID-67-498, V. 10) CFSTI: $3.00 CSCL 20K

The shell of revolution program was developed as a basic tool to be used in the elastic, load-deflection analysis of shell structures subjected to arbitrary loads and temperatures. The program is applicable to most aerospace-type shell elements (e.g., boosters, reentry vehicles, etc.) as well as ground-based shells. The computer program is restricted to linear-elastic thin-shell theory. The analysis utilizes a Fourier series expansion technique to separate circumferential variation of problem variables. By introducing fictitious subdivisions called shell regions, it is possible to analyze complicated shell configurations as a series of shell regions of simple shapes. The procedures for connecting shell regions require the satisfaction of boundary and junction conditions in the program. The computer program was developed in a general fashion to permit the consideration of variety of shell problems. Various option techniques have been used to permit more generality and still keep data input at respectable minimum. The solutions obtained from the program yield deformations, forces, moments, stresses, etc., at each station of a shell region. Author

N68-12067# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics.

A CYLINDRICALLY ORTHOTROPIC ELASTIC THICK RING

W. R. Spillers Sep. 1967 24 p refs
(Contract Nonr-266(78))
(TR-40; AD-660686)

A Fourier series analysis is presented for the static problem of a plane elastic, cylindrically orthotropic, thick ring subjected to two equal and opposite forces applied to its outer surface at opposite ends of a diameter. Using this solution, it is possible to compute the response in regions not near the points of application of the loads. It is shown that technical beam theory becomes very inaccurate as the material becomes more and more orthotropic. Author (TAB)

N68-12088* Aerojet-General Corp., Azusa, Calif. Von Karman Center.

GLASS-FIBER-REINFORCED METALLIC TANKS FOR CRYOGENIC SERVICE Final Report, 18 Jun. 1965–15 Apr. 1967

E. E. Morris Jun. 1967 314 p refs
(Contract NAS3-6292)
(NASA-CR-72224; Rept.-3422) CFSTI: $3.00 CSCL 13D

Advantages of the design requirements for a load-bearing metal shell with an overwrapped glass-filament shell for high-pressure-fluid storage at 75 to −423°F were investigated analytically and experimentally. Proper design permits utilization of the maximum load-bearing capabilities of both shells and makes possible tanks of significantly lighter weight than the best cylindrical and spherical homogeneous metal pressure vessels. Glass-fiber-reinforced metal tanks were fabricated and tested; they successfully met design objectives in cyclic fatigue, creep, and burst tests in the 75 to −423° F range, and should be considered

for application to aerospace systems. The testing (1) confirmed the results of a parametric study of the vessels, (2) revealed that no degradation in tank strength resulted from cyclic-fatigue and sustained-loading tests at 75, −320, and −423°F, and (3) established that vessel strength increased about 25% at cryogenic temperatures. Author

N68-12095# Aerospace Corp., San Bernardino, Calif.
BUCKLING OF CIRCULAR CYLINDRICAL SHELLS WITH MULTIPLE ORTHOTROPIC LAYERS AND ECCENTRIC STIFFENERS Technical Report, Apr.–Aug. 1967
Robert M. Jones Sep. 1967 53 p refs
(Contract F04695-67-C-0158)
(TR-0158(53820-10)-1; SAMSO-TR-67-29; AD-660535)

An exact solution is derived for the buckling of a circular cylindrical shell with multiple orthotropic layers and eccentric stiffeners under axial compression, lateral pressure, or any combination thereof. Classical stability theory (membrane prebuckled shape) is used for simply supported edge boundary conditions. The present theory enables the study of coupling between bending and extension due to the presence of different layers in the shell and to the presence of eccentric stiffeners. Previous approaches to stiffened multilayered shells are shown to be erratic in the prediction of buckling results due to neglect of coupling between bending and extension. Author (TAB)

N68-12113# Army Materials Research Agency, Watertown, Mass.
RESIDUAL STRESSES IN AN OVERSTRAINED THICK-WALLED CYLINDER
Samuel J. Acquaviva Sep. 1967 10 p
(AMMRC-TR-67-03; AD-661053)

Radial and tangential residual stresses are determined as a function of stress relief temperature. Disks were sliced from a hydraulically overexpanded cylinder and subjected to various heat treatments. Residual stresses remaining after heat treatment were determined by removing material from the outer periphery of the disks. Strains were measured on the bore of the disk as a function of the amount of material removed. The maximum tangential residual stress at the bore was 55,000 psi with no stress relief treatment. At a stress relief temperature of 1050F, there was no measurable residual stress. Author (TAB)

N68-12117 Environmental Science Services Administration, Boulder Colo. Inst. for Environmental Research.
MORPHOLOGY AND TRAJECTORIES OF FRACTURES GENERATED BY INTERSECTING IMPULSIVE STRESS WAVES
John S. Rinehart Sep. 1967 11 p Symp. High Dyn. Pressure, Paris, 11–15 Sep. 1967

Many fractures, which are commonly categorized as corner fractures and spalling, develop when two transient stress waves interact. The positions and shapes of the intersecting wave fronts control the location of the gross fracture surface which has had its genesis in a large number of microfractures. The nature of these latter are regulated by the relative intensities of stress in the two intersecting waves. The problem, treated in a general fashion, leads to a microfracture orientation function. A most significant conclusion is that, generally, microfractures do not lie parallel to the main fracture surface, causing this surface to be rough and flaky. The orientation of the microfractures depends upon the relative stresses in the waves. Author

N68-12135# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STABILITY CRITERIA OF SHELLS [O KRITERIYAKH USTOYCHIVOSTI OBOLOCHEK]
A. S. Vol'mir 23 Dec. 1966 25 p refs Transl. into ENGLISH from Raschet Prostranstvennykh Konstrukt. Sb. Statey, Izd-vo Lit. po Stroit. (Moscow), no. 9, 1964 p 117–129
(FTD-HT-66-377; AD-661030)

The establishment of general stability criteria of shells is of an enormous practical importance. Calculations for stability for many constructions are encountered in industrial installations, aviation, ship construction, etc., and they appear to be decisive with respect to the selection of material and dimensions. In spite of the presence of a great amount of literature on the stability of shells, it is still impossible to determine firmly the destructive loads and calculated stresses for even relatively simple cases of applying outer forces. This is explained first of all by substantial features of the process of shell stability losses connected, as a rule, with the appearance of snapping. Stability investigations of shells cannot be acknowledged as completed as long as there is no definition with respect to the very concept of stability. This appears to be particularly substantial for the arrangement and solving of problems pertaining to the stability of shells in the presence of plastic deformations, under creep conditions, with dynamic loads, etc. Stability concepts of different solutions of problems are discussed in the qualitative theory of differential and integral equations and in a functional analysis. TAB

N68-12157# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
RANDOM NOISE AND VIBRATION IN SPACE VEHICLES
Richard H. Lyon Washington, D. C. Defense Dept. 1967 74 p refs
(Contract N00014-66-C0271)
(SVM-1; AD-660530) GPO: $1.50

Contents: Introduction (prediction of the environment, calculation of response, simulation of environmental loads); Flight vehicle noise environment (acoustic environment, inertial aerodynamic loads, compressible aerodynamic loads); Estimation of vehicle response (empirical and semi-empirical methods, rational approaches to response estimation); Testing for environmental effects (purposes of environmental testing, how specifications are set, direct environmental simulation, simulation by environmental substitution). TAB

N68-12203# Los Alamos Scientific Corp., N. Mex.
AN ENGINEERING APPROACH TO MULTIAXIAL PLASTICITY
J. G. Merkle Jul. 1967 100 p refs
(Contract W-7405-ENG-26)
(ORNL-4138) CFSTI: HC $3.00/MF $0.65

A straightforward derivation of the basic equations of plasticity is presented. The basic equations are derived by using only calculus and vector algebra; tensor notation is not used. All assumptions are explicitly stated. The flow rule is derived by two different methods. In one method the area under the effective stress–strain curve is assumed to equal the plastic work. For the other method the plastic material is assumed to be "stable." In both derivations the ratios of the principal plastic strain increments are uniquely determined by the state of stress at any point on the yield surface, except at a discontinuity. Plastic volume changes are related to the effects of hydrostatic pressure on the yield function. The equations of Hill's yield function and the Mohr–Coulomb yield function are examined. The plastic volume changes associated with the Mohr–Coulomb yield function are examined. Two example problems are solved: one uses Hill's yield function and the other the Mohr–Coulomb yield function. Author (NSA)

N68-12208# Naval Ship Research and Development Center, Washington, D. C. Structural Mechanics Lab.
RATIONAL SHOCK MOUNT DESIGN, INVESTIGATION OF EFFICIENCY OF DAMPED, RESILIENT MOUNT

Kenneth T. Cornelius Jul. 1967 22 p refs
(NSRDC-2383; AD-660660)

The concept of ideal, or optimum, shock mount behavior is developed and offered as a standard for use in judging the efficiency of real mounts. The behavior of a shock mount consisting of a linear spring in parallel with a linear, bilateral damping link in response to experimentally determined shipboard shock motions is predicted. Computations are made for natural frequencies ranging between 5 and 20 Hz and for damping ratios up to 60 percent of critical. The effect on mount performance of variations in natural frequency, damping ratio, and characteristics of the input motion is discussed. One way of improving the efficiency of the mount is discussed briefly. This type of mount is judged to be rather inefficient, but it does have the advantage of maintaining its equilibrium position. Author (TAB)

N68-12231# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.

A REVIEW OF THE APPLICABILITY OF THE "SOUTHWELL" PLOT TO THE INTERPRETATION OF TEST DATA OBTAINED FROM STABILITY STUDIES OF ELASTIC COLUMN AND PLATE STRUCTURES

W. H. Horton, F. L. Cundari, and R. W. Johnson Dec. 1966 131 p refs
(Contract DA-44-177-AMC-258(T); AF 49(638)-1495)
(SUDAAR-296; AFOSR-67-1441; AD-660584)

The paper coordinates and extends the researches of some twenty engineers made over a century and a half in what may be broadly called the Southwell plot technique for interpreting the stability of structures. It demonstrates the power and versatility of the method of expressing the given hyperbolic equation in a linear form by change of variables and determining the classic critical load as the slope of this line. The results obtained show that there can be no doubt as to the applicability of the method to all linear instability problems of plates. Thus it corrects the statements of previous researchers who have been hampered in their work by the lack of valid experiments arising from the coarseness of measurement techniques. There is clear indication that continued study will open the door to a clearer understanding of the perplexing questions which arise in compressive elements in which curvature is present. Author (TAB)

N68-12233# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE EFFECT OF STIFFENING SHALLOW SHELLS OF REVOLUTION SUBJECT TO SYMMETRICAL LOADING [OB EFFEKTE PODKREPLENIYA POLOGIKH. SIMMETRIC HNO NAGRUZHENNYKH OBOLOCHEK VRASHCHENIYA]

V. M. Mitkevich and A. K. Shulika 28 Feb. 1967 13 p refs
Transl. into ENGLISH from Prikl. Mekhanika (USSR), v. 2, no. 7, 1966 p 58–64
(FTD-HT-67-27; AD-660762)

A discussion is presented of the relationship between the stiffening of shallow shells of revolution by stringers in the meridional direction and the stress and strain states in the shells. The case of a frustum of a conical shell with stiffeners in the longitudinal direction is analyzed. The slope angle of the shell varies from zero to pi/6. The shell is considered structurally orthotropic on the basis of known equilibrium equations (in terms of forces and moments) for an element of an axisymmetric shell, elasticity relationships, and equations for continuity of strains in the middle surface. The problem is reduced to the solution of a system of five regular differential equations. The system was integrated by the numerical Adams method on an Ural-2 electronic digital computer. A standard program developed and the Institute of Mechanics of the Academy of Sciences Ukrainian SSR was utilized. The calculations were carried out for frustums of conical shells of constant thickness (plain and stiffened by constant-cross-section stringers). The bottom base of the shells was fixed; the upper was free. Two cases of loading were considered: constant internal pressure and axial force. The results obtained are plotted in diagrams and compared, and the effects of stiffening on certain stress and strain parameters for various slope angles are discussed. Author (TAB)

N68-12237* General Dynamics/Convair, San Diego, Calif.

THE STABILITY OF ECCENTRICALLY STIFFENED CIRCULAR CYLINDERS. VOLUME 4: GENERAL INSTABILITY OF CYLINDERS HAVING LONGITUDINAL AND CIRCUMFERENTIAL STIFFENERS; AXIAL COMPRESSION

G. W. Smith, E. E. Spier, and E. A. Muscha 20 Jun. 1967 173 p refs
(Contract NAS8-11181)
(NASA-CR-91141; GD/C-DDG-67-008, V. 4) CFSTI: $3.00 CSCL 20K

This is the fourth of six volumes, each bearing the same report number, but dealing with separate problem areas concerning the stability of eccentrically stiffened circular cylinders. This particular volume deals with the general instability of simply supported, axially compressed circular cylinders which have longitudinal and circumferential stiffening (stringers and rings). Analysis methods are presented in the forms of curves and a digital computer program. Since the contents of this volume are based upon a Donnell-type small-deflection theory, the proposed methods should be used in conjunction with empirical knock-down factors to account for the effects of initial imperfections. In addition, the Donnell assumptions preclude application to non-axisymmetric buckle patterns where the number of circumferential waves is small. Author

N68-12263# Picatinny Arsenal, Dover, N. J. Plastics and Packaging Lab.

EFFECT OF MECHANICAL PROPERTIES OF ADHEREND ON ADHESIVE BOND STRENGTHS

Raymond F. Wegman, Andrew T. Devine, Charles L. Vacher, and M. Douglas Anderson Oct. 1967 23 p refs
(PA-TR-3602; AD-661040)

The report demonstrates that the strength of an adhesive-bonded lap joint increases linearly with the length of the lap up to a load determined by the mechanical properties of the adherend. This is true for any adherend provided that it is homogeneous and that the failure is cohesive. Plots of lap length/adherend thickness versus load, referred to as L/t curves, showed an unexpected and unexplained plateau in the curve prior to the familiar asymptotic leveling normally seen. These plateaus have either been ignored or unrecognized in the past. Preliminary examination of the plateaus shows that they occur at the (Sy) value, defined as approximately 55% of the load at which the tensile yield of the adherend is reached. Their location on the curve depends upon the thickness and type of adherend used. Several sets of graphs are presented in support of the concept that the mechanical properties of the adherend limit the performance of adhesives in adhesive-bonded joints. Author (TAB)

N68-12296 Technische Univ., Berlin (West Germany). Inst. fuer Konstruktionslehre.

CALCULATING OF TILTED SURFACE WING-TRUSS STRUCTURES [UEBER DIE BERECHNUNG SCHIEFWINKLIGER FLAECHENTRAGWERKE]

Ernest Giencke Oct. 1967 25 p refs In GERMAN Presented at Lecture on WGLR/DGRR Yearly Congr., Karlsruhe, West Germany, 1967

Structural calculations for tilted aircraft surfaces are performed by using finite differential equations that contain the necessary dynamic components. Matrix methods for oblique coordinates project x and y as the wing level and z as the slanted construction angle;

displacement and intersecting values are then developed by full scale stiffness and elasticity matrix analyses. Transl. by G.G.

N68-12299 Vereinigte Flugtechnische Werke G.m.b.H., Bremen (West Germany).
STRINGERS AND RIBS OF REINFORCED CYLINDERS UNDER INNER SUPER-PRESSURE [DER DURCH STRINGER UND SPANTE VERSTEIFTE ZYLINDER UNTER INNEREM UEBERDRUCK]
O. Volkersen [1967] 34 p refs In GERMAN Presented at the WGLR/DGRR Ann. Meeting, Karlsruhe, West Germany, Oct. 1967 (Rept.-19) CFSTI: $3.00

Presented is an approximate solution for the nonlinear problem of circumferential tension in a thin-walled circular pressure vessel reinforced by ribs and stringers. Strain and stress values obtained are compared with membrane tension of isotropic pressure cylinders, with axial bending stresses along the ribs of the isotropic cylinders, and with calculated tensions on orthotropic reinforced cylinders. Parametric correlations of the obtained values improved the fatigue factor in the design of airplane pressure cabins.
Transl. by G.G.

N68-12370*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STRUCTURAL FEASIBILITY STUDY OF PRESSURIZED TANKS FOR LIQUID-METHANE FUELED SUPERSONIC AIRCRAFT
Rene E. Chambellan, Joseph F. Lubomski, and William A. Bevevino Washington Dec. 1967 48 p refs
(NASA-TN-D-4295) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Light-weight pressurized tanks for the storage of liquid-methane fuel in the wings of supersonic transport aircraft were evaluated. Three types of tank structures were studied: (1) membrane tanks where the only loads in the tank skin are tensile, (2) modified semimonocoque tanks composed of a framework of rings and stringers covered by a pressure-tight skin, and (3) filamentary restrained membrane tanks where the outer skins of either metal or sealed fabric are restrained by wires or threads attached to the opposite skin. A typical wing void space having an approximately rectangular prismoidal shape was assumed as a tank envelope. The various tank designs were compared by the use of two numerical ratios, namely, the volumetric efficiency and tank-weight to contained-fuel-weight ratio. Volumetric efficiency is defined as the ratio of the volume of fuel stored in the tank to the storage void volume into which the tank is fitted. For the designs considered, exclusive of insulation, volumetric efficiencies ranged from 81.1 to 99.6 percent and tank-weight to contained-fuel-weight ratios ranged from 0.0241 to 0.0556. Author

N68-12371* General Dynamics/Convair, San Diego, Calif.
THE STABILITY OF ECCENTRICALLY STIFFENED CIRCULAR CYLINDERS. VOLUME 2: BUCKLING OF CURVED ISOTROPIC SKIN PANELS; AXIAL COMPRESSION
G. W. Smith, E. E. Spier, and L. S. Fossum 20 Jun. 1967 103 p refs
(Contract NAS8-11181)
(NASA-CR-91222; GD/C-DDG-67-006, V. 2) CFSTI: HC $3.00 CSCL 20K

This is the second of six volumes, each bearing the same report number, but dealing with separate problem areas concerning the stability of eccentrically stiffened circular cylinders. This particular volume presents a practical method for the determination of design values for the critical buckling stresses of axially compressed, curved isotropic skin panels having various degrees of edge restraint. For wide panels which behave essentially as full cylinders, the method provides lower-bound predictions. As the panel width decreases, a transitional relationship is employed which, for narrow panels, approaches standard flat plate values. In order to facilitate ready application, this volume includes several groups of design curves as well as a digital computer program which provides either automatic plotting or single-point solutions, as desired. Author

N68-12372* General Dynamics/Convair, San Diego, Calif.
THE STABILITY OF ECCENTRICALLY STIFFENED CIRCULAR CYLINDERS. VOLUME 6: INTERACTION BEHAVIOR
G. W. Smith, E. E. Spier, S. N. Dharmarajan, and L. S. Fossum 20 Jun. 1967 71 p refs
(Contract NAS8-11181)
(NASA-CR-91224; GD/C-DDG-67-006, V. 6) CFSTI: $3.00 CSCL 20K

This is the last of six volumes, each bearing the same report number, but dealing with separate problem areas concerning the stability of eccentrically stiffened circular cylinders. This particular volume includes a digital computer program which determines critical combinations of axial load (tension or compression) and radial pressure (bursting or crushing). No consideration is given to the influences of prebuckling distortions from the true cylindrical shape. The foregoing theoretical solution is extended to incorporate the influences of external running shear acting either alone or in combination with axial load and/or radial pressure. The extended solution is also presented here. In addition, some discussion is given of the case where eccentrically stiffened cylinders are subjected to overall bending acting either alone or in combination with axial load. Author

N68-12390# California Univ., Berkeley.
A STUDY OF THE NOTCHED-BAR CREEP-RUPTURE TEST Final Report
I. Finnie 30 Sep. 1967 11 p
(Grant DA-ARO(D)-31-124-G551)
(AROD-4656-2-E; AD-661322)

The uncertainty about the use of the Odqvist equations for strain predictions under biaxial tension with constant principal stress ratios and principal stress directions held fixed was resolved. Tests were run with varying stress ratios but no general conclusions were reached. Attempts to obtain a better understanding of creep-rupture by separating the initiation and propagation phases of fracture led to very encouraging results. Although the model used may turn out to be too simplified it appears to explain a number of features of creep-rupture in smooth and notched bars. Analytical studies on notched members were only partially successful. The study of the two-dimensional case of a flat strip with notches was completed, but the three-dimensional case of a rod with a circumferential notch was abandoned. Numerical solution of three-dimensional elastic-plastic or elastic-creep problems turned out generally to be more difficult than anticipated. This is unfortunate for experiments on notched strips cannot simulate the constraint present in the case of circumferentially notched rods. TAB

N68-12402# Naval Ship Engineering Center, Washington, D. C. Underwater Explosions Research Div.
THE INFLUENCE OF A MASS ON THE FREE FLEXURAL VIBRATIONS OF A CIRCULAR RING
E. W. Palmer Aug. 1967 51 p refs
(Rept.-2536; AD-661226)

The general solution is obtained for the free flexural vibrations of a thin circular ring containing a point mass. The solution for a uniform ring alone is derived by taking the point mass to be zero. Numerical calculations of the frequencies of the first and second flexural modes are presented for values of the point mass in the range from zero to infinity. Mode shapes are presented in graphical form. The predominant feature of the investigation is the difference in frequency and mode shape found in the symmetrical and

antisymmetrical branches of each mode. It is noted that similar phenomena have been observed experimentally for vibrations of imperfect bodies of revolution. Author (TAB)

N68-12456* General Dynamics/Convair, San Diego, Calif.
THE STABILITY OF ECCENTRICALLY STIFFENED CIRCULAR CYLINDERS. VOLUME 1: GENERAL
G. W. Smith and E. E. Spier 20 Jun. 1967 29 p refs
(Contract NAS8-11181)
(NASA-CR-91223; GD/C-DDG-67-006, V. 1) CFSTI: $3.00 CSCL 20K

This is the first of six volumes, each bearing the same report number, but dealing with separate problem areas concerning the stability of eccentrically stiffened circular cylinders. The complete set of documents furnishes workable design and analysis methods for the prediction of instability in such structures. The overall multiple-volume report includes design curves, procedures, and digital computer programs for the most important buckling modes. The material presented in this first volume provides an introductory background which puts the subsequent volumes in a proper perspective. Author

N68-12470# Los Alamos Scientific Lab., N. Mex.
HUGONIOTS OF GRAPHITES OF VARIOUS INITIAL DENSITIES AND THE EQUATION OF STATE OF CARBON
R. G. McQueen and S. P. Marsh [1967] 8 p refs Presented at the Intern. Symp. on the Behavior of Dense Media Under High Impulsive Pressures, Paris
(Contract W-7405-ENG-36)
(LA-DC-8411; CONF-670914-12) CFSTI: HC $3.00/MF $0.65

The Hugoniot equation of state of several graphites and diamond was measured using the shock-wave impedance-match technique. The graphites tested were pyrolytic, pressed (3 compositions), ZTA, ATJ, and PT 0178. The results are tabulated and plotted as shock-particle velocity and pressure–density Hugoniot graphs. The low, intermediate, and high pressure ranges are discussed. Other measurements are also described. NSA

N68-12503* General Dynamics/Convair, San Diego, Calif.
THE STABILITY OF ECCENTRICALLY STIFFENED CIRCULAR CYLINDERS. VOLUME 3: APPENDIX
G. W. Smith and E. E. Spier 20 Jun. 1967 119 p
(Contract NAS8-11181)
(NASA-CR-91221; GD/C-DDG-67-006, V. 3) CFSTI: $3.00 CSCL 20K

Supplementary data are presented on the critical stress curves of compressive buckling for longitudinally stiffened cylinders made of 7075-T6 aluminum alloy, 6Al–4V titanium alloy, and 718 nickel (annealed and double aged). Nondimensional curves which are not restricted to a single material are plotted. M.G.J.

N68-12519 Novosibirsk State Univ. (USSR). Thermal Physics Inst.
PHASE TRANSITIONS IN SOLIDS INDUCED BY SHOCK WAVES
E. D. Ruchkin, I. A. Ovsjannikova, and S. S. Batsanov 1967 9 p refs Presented at the Symp. on High Dyn. Pressure, Paris, 11–15 Sep. 1967

Polymorphic conversions in rare earth metal oxides and in manganese fluoride, induced by shock waves from explosives are described. New phase transitions in uranium, thorium, and rare earth metal fluorides were also studied. Infrared spectra of rare earth metal oxides; diffractograms of ThF_4 gamma phases; and X-ray absorption spectra of Ce, are depicted. L.S.

N68-12542*# North American Aviation, Inc., Downey, Calif. Space Div.
STUDY OF APOLLO WATER IMPACT. VOLUME 8: USER'S MANUAL—INTERACTION Final Report
J. P. D. Wilkinson and R. N. Salzman May 1967 182 p
(Contract NAS9-4552)
(NASA-CR-65861; SID-67-498, V. 6) CFSTI: $3.00 CSCL 20K

This volume is a user's manual for a computer program which determines the hydroelastic response of a flexible shell of revolution during an axially symmetric impact into an incompressible fluid. The program uses the hydroelastic theory developed in Volume 3 of this report where the interaction between the fluid and the shell is accounted for. Author

N68-12552# Forest Products Lab., Madison, Wis.
ELASTIC STABILITY OF CYLINDRICAL SANDWICH SHELLS UNDER AXIAL AND LATERAL LOAD
A. Carl Maki Oct. 1967 34 p refs Revised
(FPL-0173; AD-661110)

Presents a linear solution for determining the effect of combined axial and lateral loads under which a cylindrical sandwich shell will buckle. Author (TAB)

N68-12558 Aeronautical Research Council (Gt. Brit.)
TECHNIQUES FOR TESTS ON STRUCTURES SUBJECT TO KINETIC HEATING
P. Talbot London HMSO 1967 24 p refs Supersedes RAE-TR-66382; ARC-29160
(ARC-CP-970; RAE-TR-66382; ARC-29160) CFSTI: $3.00

The main requirements of aircraft static tests are stated. The extent and effects of kinetic heating are described, and various methods of simulating and controlling heating in the laboratory are discussed. The further problem of kinetic cooling leads to the technique of heating and cooling by convection where the heating rate is low. Measurements and test observations are discussed with reference to the safety of the specimen. The application of simulated kinetic heating to static tests is described and reference is made to the special difficulties and needs of the hot fatigue test. Author

N68-12614 Washington State Univ., Pullman. Shock Dynamics Lab.
SHOCK-INDUCED PHASE TRANSITION IN IRON
Y. Horie and G. E. Duvall 1967 10 p refs Presented at the Symp. on High Dyn. Pressure, Paris, 11–15 Sep. 1967
(Contract DA-04-200-AMC-1702(X); Grant AF-AFOSR-1088-66)

The effects of finite reaction rate on shock profiles and first-wave amplitudes are examined in detail. The discussion is based on the assumptions that the two phases have common particle velocity, pressure, and temperature, and that there is no interfacial energy. The solutions to the resulting equations for a constant pressure of 200 kilobars applied to the surface of a half-space are presented in graph form. It is found that a definite 2-wave structure is not present at first but develops as the amplitude of the first wave decays toward the equilibrium value of 130 kilobars. The data indicate that the viscous stress is important in the first shock front, but that the relaxation process controls the rise time in the second shock. N.E.N.

N68-12617*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MARINER VENUS 67 STRUCTURAL DEVELOPMENTAL AND QUALIFICATION VIBRATION TEST REPORT
R. E. Freeland 1 Nov. 1967 52 p refs
(Contract NAS7-100)
(NASA-CR-91220; JPL-TR-32-1161) CFSTI: HC $3.00/MF $0.65 CSCL 20K

This report describes the structural developmental forced-vibration test program accomplished on the *Mariner V* structural test model. Data included are concerned with sine-wave excitation from 5 to 200 Hz along lateral and axial axes of the spacecraft, and with modulated sine and multifrequency pulse-type excitation introduced torsionally. Implementation of dynamic test loads and supporting instrumentation, data recording, and analysis are discussed. Dynamic response characteristics of major substructures are evaluated with respect to structural integrity and correlation to structural analysis; this includes the pressure-dependent response of the post-injection propulsion system and the response of the tip-latched and viscous-damped solar panels. The effect of spacecraft elastic torsional response when subjected to modulated sine wave excitation, as compared with multifrequency transient excitation, is discussed. Test data verified the *Mariner V* to be structurally adequate to satisfy mission objectives. Author

N68-12652 Aeronautical Research Council (Gt. Brit.).
THE COMBINATION OF STATISTICAL DISTRIBUTIONS OF RANDOM LOADS
N. I. Bullen 1967 19 p refs Supersedes RAE-TN-STRUCT-326; ARC-25175
(ARC-R&M-3513; RAE-TN-STRUCT-326; ARC-25175)

The case of a random Gaussian process for which the root-mean-square value is itself variable is considered. A distribution for the root-mean-square value is assumed and an expression is derived for the resulting distribution of peak values of the variable quantity. This expression is shown to give good agreement with experimental results in many cases of aircraft gust load statistics, and its limitations are discussed. Author

N68-12665 General Electric Co., Philadelphia, Pa. Missile and Space Div.
SENSITIVITY OF HYPERVELOCITY IMPACT MECHANISMS TO PROJECTILE-PLATE CONFIGURATIONS
T. D. Riney [1967] 5 p refs Presented at the High Dyn. Pressure Symp., Paris, 11–15 Sep. 1967

The response of thin plate targets to hypervelocity impact has been calculated under conditions that insure that the impact and penetration mechanisms are governed by a compressible fluid model; and a particle-in-cell computer code capable of treating axisymmetric projectile-target configurations of three different materials was used. Layered meteoroid bumpers are discussed; and it is concluded that the main factor in the defeat of a projectile by the bumper and resultant debris dispersal is the mass per unit area of the bumper, as long as the peak pressures realized in the central region of the projectile-bumper configuration are sufficiently large for the debris cone materials to be in a molten state due to the residual heat after shock processing. Shock focusing in thin targets is also discussed. M.W.R.

N68-12744 Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science.
SOME ANALYTICAL AND EXPERIMENTAL INVESTIGATIONS ON HIGH VELOCITY ELONGATION OF SHEET MATERIALS BY TENSILE SHOCK
K. Kawata, S. Fukui, J. Seino (Shinshu Univ. of Japan), and N. Takada 1967 22 p refs Presented at the Meeting on High Dyn. Pressure, Paris, 11–15 Sep. 1967

In the present paper, high velocity elongation of sheet materials by tensile shock is investigated by experimental means as well as by theoretical ones. It is found that breaking elongation in high velocity tension is frequently larger than statical ones for some metals, but smaller for the others. To clarify the relation between the crystal structures of metals, a series of high velocity tests are carried out. A newly developed high velocity loading machine using explosion pressure which may realize tensile speeds up to 200 meters/sec. is used. Author

N68-12797# Advisory Group for Aerospace Research and Development, Paris (France).
HANDBOOK OF BRITTLE MATERIAL DESIGN TECHNOLOGY
W. H. Dukes Oct. 1966 47 p refs Presented at 23d Meeting of Struct. and Mater. Panel of AGARD, Paris, Oct. 1966
(AD-661162)

Contents: Principles of brittle material; Establishment of design stresses. TAB

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N68-11931*# Martin Co., Denver, Colo. Aerospace Div.
TRANSIENT HEAT AND MASS TRANSFER ANALYSIS OF SUPERCRITICAL CRYOGENIC STORAGE SYSTEMS WITH SPHERICAL STATIC HEATERS Final Report
R. N. Eberhardt, B. K. Larkin, and H. R. Richards Dec. 1965 109 p refs
(Contract NAS9-4444)
(NASA-CR-91075; CR-65-86) CFSTI: $3.00 CSCL 20M

The problem of heat and mass flow in a single phase cryogenic storage system has been treated. Equations describing the system were developed, thermodynamic and transport data were assembled, and a Fortran computer program was written to solve the problem. Fluids considered were oxygen, hydrogen and helium. The program can accommodate any vessel geometry; both fluid withdrawal rate and input heat leak may be arbitrary functions of time. The theoretical concepts which were employed are: conservation of mass, conservation of energy, and Fourier's Law for heat flow. To test the Fortran program, the performance of an oxygen supply sphere was studied. Of the initial charge of 27 lbs. of LOX, nearly 2 lbs. were vented, 23.6 lbs. were supplied, and 1.4 lbs. remained in the sphere at the end of the mission. Fluid temperatures varied from 198° to over 450°R. Pressure increased from 80 psia to 1000 psia in 786 min. During the supply period, pressures varied ±75 psi about the control level of 900 psia. About 1500 Btu of electrical energy were delivered to the heaters in order to maintain pressure. These results indicate that the program is operational. Author

N68-12008# Naval Ordnance Lab., White Oak, Md.
A DIGITAL COMPUTER PROGRAM FOR MAKING COMPARATIVE AERODYNAMIC HEAT TRANSFER AND SKIN FRICTION DRAG CALCULATIONS
Donald M. Wilson 25 Aug. 1967 23 p refs
(NOLTR-67-137; AD-660688)

A program is presented for calculating laminar and turbulent boundary layer heat transfer and skin friction drag on either a flat plate or a sharp cone during high-speed flight. Three turbulent skin friction laws, the Winkler-Cha, the Spalding-Chi and the Blasius-Sommer and Short are used so that comparative values can be found. The calculations are provided by a computer program which was written for an IBM 7090 computer operating under the IBSYS monitor. The mathematical formulations of the skin friction laws and the computer program are presented. Included with the program is a complete Fortran listing and all necessary instructions required for its use. Author (TAB)

N68-12019*# Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.
PREDICTION OF ELECTRON DENSITY IN ROCKET EXHAUST PLUMES
R. J. Prozan and B. J. Audeh Oct. 1967 33 p refs
(Contract NAS8-21022)
(NASA-CR-91061; LMSC/HREC-A784870; HREC-1022-1) CFSTI: HC $3.00/MF $0.65 CSCL 21B

The prediction of electron density in rocket exhaust plumes is based on a detailed description of several flow regimes and chemistry models. The analytical methods which are discussed in this report represent a set of analysis techniques and computer programs. To discuss the theoretical approach taken to each of the disciplines involved is beyond the scope of this report. This report, however, is intended to acquaint the reader with the controlling phenomena, basic analytical approach taken to the description of these phenomena, and to present sample calculations that will illustrate important aspects of the problem. For a detailed description of the analytical approach, derivation of equations, assumptions, etc., the reader is referred to the supporting documentation. Author

N68-12036 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
FUTURE TRENDS IN CHEMICAL PROPELLANTS [PERSPECTIVES D'AVENIR DANS LE DOMAINE DES PROPERGOLS CHIMIQUES]
Marcel Barrere and Bernard Crampel 1967 60 p refs In FRENCH; ENGLISH summary Presented at the 18th Intern. Astronautic Congr., Belgrade, 25–29 Sep. 1967
(ONERA-TP-516(1967)) CFSTI: $3.00

Selection criteria are defined, stressing the fact that an increase in performance often means an increase in development cost. The present status of this problem is reviewed, with emphasis on the possibilities offered by propellant chemistry and which propellants could be used in the future are indicated. Author

N68-12057* Stevens Inst. of Tech., Hoboken, N. J. Dept. of Mechanical Engineering.
FLAME SPREADING AT ELEVATED PRESSURES OVER THE SURFACE OF IGNITING SOLID PROPELLANTS AND PROPELLANT INCREDIENTS IN OXYGEN/INERT ENVIRONMENTS Annual Report
Robert F. Mc Alevy, III and Richard S. Magee Oct. 1967 34 p refs
(Grant NGR-31-003-014)
(NASA-CR-90752; ME-RT-67011) CFSTI: $3.00 CSCL 21B

Flame spreading velocity (V) was measured at various levels of oxygen mole fraction (Y_{ox}) and total pressure (P) for two types of nitrate ester propellants, and two thermoplastics typical of composite propellant fuel binders. The propellants were tested in mixtures of oxygen and nitrogen; the thermoplastics in mixtures of oxygen and nitrogen, oxygen and argon, and oxygen and helium. The data obtained favor the concept that flame spreading over the surface of an igniting condensed phase material, in a quiescent environment containing a component with which it can undergo exothermic chemical reaction, proceeds by continuous, diffusive gas phase ignition. An improved mathematical method is described for analyzing these phenomena. The experimentally determined $V(P,Y_{ox})$ generally supported the results of this analysis over an extremely wide range of independant parameter variations. Power law dependences, with constant exponents for each system tested, provided correlation of V with P and Y_{ox} over the entire range of parameters. M.G.J.

N68-12128*# Stanford Research Inst., Menlo Park, Calif.
PROPELLANT COMBUSTION PHENOMENA DURING RAPID DEPRESSURIZATION Final Report
C. E. Wooldridge, G. A. Marxman, and E. L. Capener 31 Oct. 1967 121 p refs Prepared for NASA
(NASA-CR-66500) CFSTI: HC $3.00/MF $0.65 CSCL 21B

The theoretical studies carried out during this program were concerned with the analysis of an idealized combustion model in which, in addition to surface pyrolysis and gas-phase chemical reactions, exothermic or endothermic reactions are permitted at or very near the solid-gas interface and are therefore coupled with the thermal response of the solid. These surface-coupled reactions are assumed to occur in a zone of negligible thickness, relative to the penetration depth of the thermal profile, so that the associated heat release can be treated as a boundary condition on the solid phase. The results of the analysis of the model show that a relatively small proportion of surface-coupled heat release (e.g., 10 percent) has a profound effect on the burning rate response to environmental pressure changes. Author

N68-12167# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
CODE FLID (DEP 051): NUMERICAL PROGRAM FOR TWO-DIMENSIONAL ANALYSIS OF THE THERMODYNAMIC BEHAVIOUR OF A BOILING LIQUID [CODE FLID (DEP 051): PROGRAMME NUMERIQUE ANALYSANT EN DEUX DIMENSIONS LE COMPORTEMENT THERMODYNAMIQUE D'UN LIQUIDE BOUILLANT]
Maurice Fajeau and Jean-Pierre Saunier Jan. 1967 60 p Transl. into ENGLISH from the French
(CEA-R-3141)

A two-dimensional code was developed for analysis of the thermal steady-state and transient behavior of a water loop at high or low pressure, and the thermal and hydrodynamic behavior of a light water reactor hot channel. The fuel elements are assumed to be flat plates. The power and pressure drop variations during transient conditions are obtained from the complementary one-dimensional code CACTUS. Author (NSA)

N68-12201 Atomic Weapons Research Establishment, Aldermaston (England).
INFRA-RED METHOD OF ESTIMATING THE RESIDUAL TEMPERATURE OF SHOCKED METAL PLATES
P. J. King, D. F. Cotgrove, and P. M. B. Slate Sep. 1967 12 p refs Symp. High Dyn. Pressure, Paris, 11–15 Sep. 1967

Details are given on the apparatus and the procedures using a photoconductive heat sensor operating in the near infrared which eliminates the difficulties inherent with thermocouple junctions subjected to shock. The detector employed is an indium antimonide photoconductive cell. The plate is first heated to predetermined temperature for calibration purposes and restored to ambient temperature. The explosive is placed in position and the shocked surface temperature is determined. Emissivity errors are minimized by measuring the radiation at two wavelengths using suitable narrow pass band filters. The reproducibility of results from polished copper was found to be high, and deviations from theoretical predictions is considered to be due to emissivity variations. N.E.N.

N68-12253 Weapons Research Establishment, Salisbury (Australia).
MECHANISM OF AMMONIA OXIDATION IN SHOCK WAVES. PART 2: WITH NITROUS OXIDE
L. J. Drummond and S. W. Hiscock Jul. 1966 38 p refs
(CPD-114) CFSTI: $3.00

Measurements have been made of the speed of reflected shocks in mixtures of argon and nitrous oxide. The results are considered in relation to the kinetics of the decomposition reaction which was studied using absorption spectroscopy at temperatures

between 1650° and 1950°K. Comparable observations were made when ammonia was added as a fuel. The presence of OH and NH radicals was confirmed and this provides information on the nature of the reactions leading up to explosion of the nitrous oxide—ammonia mixture which occurs with a negligible induction period at 1850°K.
Author

N68-12276# Contraves Corp., Zurich (Switzerland).
PASSIVE TEMPERATURE CONTROL FOR LARGE SPACE SHIPS [PASSIVE TEMPERATUR-KONTROLLE BEI GROSSEN RAUMFAHRZEUGEN]
Hans Eder [1967] 36 p In GERMAN Presented at WGLR/DGRR Ann. Meeting, Karlsruhe, West Germany, 1967
CFSTI: $3.00

A mathematical model is formulated for an orbiting satellite structure with passive temperature control. Absorption and emission properties of the satellite's surface and an energy exchange mechanism in the satellite's interior insure a regulated temperature distribution. This proposed basic satellite structure consists of 5 cells, each of which represents a thermal control unit, clustered around a thick walled hollow magnesium core. The outer walls of the configuration act as isolation barriers and control the heat exchange with the surrounding atmosphere, and the walls of the magnesium core act as heat conductors in a hot environment, and as heaters in a cold environment. Transl. by G.G.

N68-12288 India. Dept. of Atomic Energy, Bombay. Bhabha Atomic Research Centre.
THERMAL BEHAVIOUR OF SOLID RADIOACTIVE WASTE IMMERSED IN CONDUCTIVE/CONVECTIVE MEDIA—A STUDY
V. Ravindranath, Keshava Chandra, J. D. Sehgal, and K. T. Thomas 1967 28 p refs
(B.A.R.C.-288)

This report is an attempt at building a generalized mathematical model for transient and steady state heat removal from an infinitely long cylindrical radioactive source enclosed by finite or infinite, solid or fluid medium. Parametric study has been made on a combination of effects of time, source strength, diameter and Biot group of variables. The source has been taken as independent of time and space coordinates in this study. A Fortran program has been written and run on a CDC 3600 digital computer to study the effect of the above variables on temperature profiles inside the source. Nomographs have been prepared to cover a range of parameters expected to be encountered by a designer of any highly radioactive solid waste storage system. Author

N68-12363# Sandia Corp., Albuquerque, N. Mex.
THE HEAT PIPE
K. Thomas Feldman, Jr. (New Mexico Univ.) and Glen H. Whiting Mar. 1967 14 p refs
(Contract AT(29-1)-789)
(SC-TM-66-2632) CFSTI: HC $3.00/MF $0.65

The heat pipe is a unique and simple heat transfer device which has an effective thermal conductivity several hundred times that of copper. The operating principles and characteristics of the heat pipe are described. Performance characteristics, possible applications, and current research and development activities are discussed. Author (NSA)

N68-12367# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics.
THE STARTING SOLUTION FOR TWO-DIMENSIONAL HEAT CONDUCTION PROBLEMS WITH CHANGE OF PHASE
Bruno A. Boley and Harvey P. Yagoda Jun. 1967 76 p refs
(Contract Nonr-4259(07))
(TR-33; AD-660685)

A short-time solution for two-dimensional change-of-phase problems for a half space is developed. The problems are such that melting starts at a point of the surface and spreads both along the surface and towards the interior of the body. Heating is applied by an analytic but otherwise general heat input. It is found that the shape of the melt interface is, when normalized, a universal function, i.e. independent of both the applied heat input and the material properties. Initial melt propagation normal to and along the surface are proportional to y to the 3/2 power and y to the 1/2 power respectively, where y is the non-dimensional time measured from the start of melting. Author (TAB)

N68-12384# Oak Ridge National Lab., Tenn. Reactor Chemistry Div.
THE SIGNIFICANCE OF CHARCOAL IGNITION TEMPERATURES
R. J. Davis Jul. 1967 21 p refs
(Contract W-7406-ENG-26)
(ORNL-4129) CFSTI: HC $3.00/MF $0.65

Ignition temperature is defined in terms of a simple theoretical model, resulting in a working equation that relates ignition temperature to several parameters. These include: the charcoal activity (the effect of promoters, inhibitors and surface area), oxygen activity (air velocity, oxygen concentration), the stoichiometry of the chemical reaction and the activation energy of the rate-determining step of the mechanism. Use of the working equation is demonstrated. Effects of surface area, ash content, and air velocity are correlated with the working equation as the basis.
Author (NSA)

N68-12434# Bureau of Mines, Washington, D. C.
INITIATION OF SPHERICAL DETONATION IN ACETYLENE-OXYGEN MIXTURES
Elton L. Litchfield, Marilyn H. Hay, and David J. Cohen Dec. 1967 11 p refs
(BM-RI-7061)

The Bureau of Mines determined minimum energies for direct initiation of expanding gaseous detonation waves in acetylene–oxygen mixtures. Composition limit ranges for the initiation of detonation with fixed energies have been compared to data in the literature. Assuming that the stored electrical energy is completely converted to thermal energy, the agreement between the energy of primary explosive initiators and the energy of electrical discharge initiators was good. Minimum energies for initiation of detonation in the most sensitive composition (40 percent C_2H_2 plus 60 percent O_2) were: 0.64 joule at an initial pressure of 1/4 atmosphere, 5.0×10^{-2} joule at 1/2 atmosphere, and 3.7×10^{-3} joule at 1 atmosphere. Fuel concentrations in mixtures initiated to detonation by 4.9×10^{2} joules ranged from 10 to 65 percent C_2H_2 at 1/4 atmosphere, 10 to 67 percent C_2H_2 at 1/2 atmosphere, and 9 to 68 percent C_2H_2 at 1 atmosphere. Author

N68-12437*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE EFFECT OF INJECTOR-ELEMENT SCALE ON THE MIXING AND COMBUSTION OF NITROGEN TETROXIDE-HYDRAZINE PROPELLANTS
David D. Evans, Howard B. Stanford, and Robert W. Riebling 1 Nov. 1967 22 p refs
(Contract NAS7-100)
(NASA-CR-91225; JPL-TR-32-1178) CFSTI: HC $3.00/MF $0.65
CSCL 21B

The effect of injector element physical size on the mixing of unlike-impinging doublet streams of nitrogen tetroxide and hydrazine at 150 psia chamber pressure was investigated. Single impinging-jet and impinging-sheet elements of 10-, 100-, and 2000-lbf thrust were fired in a series of experiments designed to measure their degree of separation into fuel-rich and oxidizer-rich combustion zones in the resulting reactive sprays. At this chamber

pressure, very poor mixing was found at the 2000-lbf level of thrust per element for both the jets and the sheets; at 100-lbf the jets blew apart due to combustion effects, but the sheets did not; and neither jets nor sheets separated at the 10-lbf thrust scale. The severity of these combustion effects increases with the physical size of the injection elements, but the mixing process is less prone to disruption when flat sheets are used. The results indicate that mixing data obtained in nonreactive spray tests must be used with caution in the design of injectors for high levels of thrust per element. Author

N68-12442 European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.
MEASUREMENT OF THE HEAT CONDUCTIVITY OF MATERIALS FOR NUCLEAR USE BETWEEN 100° AND 500°C [MISURA DELLA CONDUCIBILITA TERMICA DI MATERIALI DI INTERESSE NUCLEARE ENTRO 100° E 500°C]
S. Giuliani Brussels Nov. 1967 40 p refs In ITALIAN; ENGLISH summary
(EUR-3644.I) CFSTI: $3.00

An apparatus has been devised for the measurement of the thermal conductivity of solid materials in the temperature range from 100°C to 500°C with an error of 6.5%. Results were obtained for UC, SAP, Magnox, graphite, and impregnated graphite. In the case of graphites, measurements were performed before and after irradiation. Author

N68-12458 Institut Franco-Allemand de Recherches, St. Louis (France).
GUIDING AND FORMING DETONATION WAVES ALONG SURFACES ALTERNATELY EXPLOSIVE AND INERT [GUIDAGE ET MISE EN FORME D'ONDES DE DETONATION LE LONG DE SURFACES ALTERNATIVEMENT EXPLOSIVES ET INERTES]
M. Defourneaux 15 Sep. 1967 5 p In FRENCH Presented at High Dyn. Pressure, Paris, 11–15 Sep. 1967
CFSTI: $3.00

Consideration is given to the propagation of detonation waves in a homogeneous explosive mass and in a heterogeneous media composed of alternate explosive and inert fibers. A method is proposed whereby the interaction between the fibers and the transmission of the detonation waves can be determined. Transl. by M.G.J.

N68-12461 Commissariat a l'Energie Atomique, Paris (France).
OUTFLOW OF BURNING GAS BEHIND THE DETONATION WAVE IN A CYLINDRICAL SHELL [ECOULEMENT DES GAZ BRULES DERRIERE L'ONDE DE DETONATION D'UNE CARTOUCHE CYLINDRIQUE]
G. Verdes, F. David, F. Prouteau, and M. Dufresne 15 Sep. 1967 5 p refs In FRENCH Presented at High Dyn. Pressure, Paris, 11–15 Sep. 1967
CFSTI: $3.00

Radiographic observations were made of gold foil submerged in the explosive, parallel and normal to the axis of the cartridge, to provide data on the line currents and velocity field in the region of stationary flow. Conservation equations of mass and momentum were derived to determine the specific mass and pressure in each point of that region. Transl. by M.G.J.

N68-12463 Commissariat a l'Energie Atomique, Paris (France).
EXPERIMENTAL STUDY OF THE GENERATION OF AN EXPLOSION IN GRANULAR PENTHRITE SUBJECTED TO A PLAIN SHOCK [ETUDE EXPERIMENTALE DE LA GENERATION D'UNE EXPLOSION DANS DES PENTHRITES GRANULAIRES SOUMISES A UN CHOC PLAN]
R. Cheret, L. Bonnet, and J. M. Lezaud 15 Sep. 1967 5 p refs In FRENCH Presented at High Dyn. Pressure, Paris, 11–15 Sep. 1967
CFSTI: $3.00

Experimental details are given on the techniques used to investigate explosive processes in granular penthrite samples of various densities when subjected to the action of a plane shock wave. In the method used, the Doppler effect is registered when the shock attains the point F_0 and when the explosion of the penthrite reaches the point F'_0 as defined by the expression $F_0F'_0=30$ m m. An oscilloscope was used to record the data. Transl. by M.G.J.

N68-12476 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
THERMAL ABLATION AND CHEMICAL ABLATION IN HYBRID COMBUSTION [ABLATION THERMIQUE ET ABLATION CHIMIQUE DANS LA COMBUSTION DES LITHERGOLS]
Jean-Francois Lieberherr 1967 29 p refs In FRENCH; ENGLISH summary Presented at the 18th Intern. Astronautic Congr., Belgrade, 25–29 Sep. 1967
(ONERA-TP-517(1967)) CFSTI: $3.00

Combustion phenomena in hybrid motors depend not only on transfer mechanisms but also on chemical kinetics. According to the experimental conditions, ablation is limited by the one or the other phenomenon, which explains the differences observed between combustion in motors and laboratory burners. A theoretical interpretation shows that the pressure sensitivity, which is required for efficient thrust modulation, can be obtained with low activation energy propellants and by favoring the surface reactions. Author

N68-12488# Massachusetts Inst. of Tech., Cambridge. Fluid Mechanics Lab.
HEAT TRANSFER AND DENSITY DISTRIBUTION MEASUREMENTS BETWEEN PARALLEL PLATES IN THE TRANSITION REGIME
William P. Teagan and George S. Springer Sep. 1967 31 p refs
(Contract Nonr-1841(93))
(Publ.-67-5; AD-660653)

The heat conduction and density distributions were experimentally determined for rarefied gases at rest contained between two unequally heated parallel plates. Both argon and nitrogen were used as test gases. Particular attention was focused on obtaining measurements in the transition regime where the ratio of plate spacing to mean free path was between 1 and 20. The gas density distribution was measured by observing the luminescence produced by a high energy electron beam traversed between the plates. The experimental results for argon were compared with the analytical results of Wang Chang and Uhlenbeck, Gross and Ziering, and Lees. In computing these results the thermal accommodation coefficient measured in the free molecule regime was used with the assumption that its value remained constant over the entire pressure range. The average agreement between the heat conduction data and the results of the four moment methods of Lees and Gross-Ziering was about 2%, while the measured density profiles agreed with the results of these analyses within 3%. Both the heat conduction and density distribution data differ by approx. 10-20% from the results of Gross-Zierings eight-moment method. Author (TAB)

N68-12535 Rocket Propulsion Establishment, Westcott (England).
PERCHLORIC ACID FLAMES. PART 7: MIXED FUEL-RICH FLAMES
G. S. Pearson Mar. 1967 34 p refs
(RPE-TR-67/3) CFSTI: HC $3.00

Fuel-rich perchloric acid flames containing binary mixtures of hydrocarbons (methane–ethane, methane–ethylene and ethane–ethylene) as fuels have been studied by sampling the burnt gas products for a range of mixtures of each pair of fuels. It has been shown that there is selective consumption of one member of each fuel pair and that the order of increasing resistance to attack is ethane < ethylene < methane. Approximate ratios of the rate constants for the attack on the fuels are deduced and compared with the literature values for hydrogen, oxygen and chlorine atom and hydroxyl radical attack on the same hydrocarbons. It is concluded that the results obtained here provide additional support for a mechanism involving chlorine-oxygen species. Author

N68-12538# Dynatech Corp., Cambridge, Mass.
INVESTIGATION OF BOILING FLOW REGIMES AND CRITICAL HEAT FLUX Quarterly Progress Report, Dec. 16, 1965–Jul. 31, 1966
A. E. Bergles, J. P. Roos, and J. G. Bourne 15 Sep. 1966 19 p refs
(Contract AT(30-1)-3304)
(NYO-3304-9; Rept.-663) CFSTI: HC $3.00/MF $0.65

The general construction and operation details of a steam system for the investigaton of boiling flow and critical heat flux are described. The steam system, which is incorporated in the water system, pumps steam from the top of the surge and separator tank. The main flow goes through a superheater and a venturi before entering the mixer. A steam loop was added to increase capacity. The loop joins the pump exit and the surge tank. Spray cooling controls the superheat of the bypass flow. With the loop, it is possible to obtain high exit qualities in large-dia tubes with the limited test-section power that is available. NSA

N68-12567 Novosibirskij Gosudarstvennyj Universitet (USSR).
PHYSICS AND CHEMISTRY OF HIGH DYNAMIC PRESSURE
S. S. Batsanov Sep. 1967 17 p refs Symp. High Dyn. Pressure, Paris, 11–15 Sep. 1967
CFSTI: $3.00

The development of a scientific trend is discussed, in which the physics and chemistry of high dynamic pressure are composed of shock wave physics, and the physics and chemistry of solids. Experimental data are given to support observations that chemical decomposition processes at the bottom of a cylindrical capsule proceed more strongly than in the upper part of the capsule subjected to high dynamic pressure. It is noted that the head shock wave configuration differs from the direction of pressure compressing material: in the axial part of the cylinder, the pressure is directed up–downward; in the other parts, it is of centripetal nature. Consideration is also given to the chemical processes studied in experiments on the conservation of an object after impact pressure. Atom and electron structural changes are assessed in relation to the transitions caused by special additives, irradiation, heating, or compression. M.G.J.

N68-12735*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RADIANT ENERGY TRANSPORT IN CRYOGENIC CONDENSATES
Dudley G. McConnell Washington 1967 19 p refs Presented at Eng. Colloq., Kentucky Univ., Lexington, 30 Nov. 1967
(NASA-TM-X-52375) CFSTI: $3.00 CSCL 20M

Radiative properties of solid condensed gases are discussed in relation to the cryodeposit radiation connected with the design of solar space simulators. An analysis of the H_2O deposit on the outside wall of a liquid hydrogen fuel tank was carried out to determine the change in frost temperature distribution, the conductive heat transfer to the cryogen, and radiation transmitted through the deposit. A heat equation was formulated with time independent and distributed radiation source terms: positive for absorption, negative for emission. The resulting temperature profile indicates that the frost temperature rises to the point where mass transfer and conduction to the substrate combine to balance the energy absorbed. E.J.S.

N68-12793 Royal Aircraft Establishment, Farnborough (England).
IGNITION OF AMMONIUM PERCHLORATE AT DIFFERENT PRESSURES [INITIERING AV AMMONIUMPERKLORAT VID OLIKA TRYCK]
T. Marklund Aug. 1967 60 p refs Transl. into ENGLISH from FOA 2 Rept. A 2322-242, Feb. 1965
(RAE-LIB-TRANS-1245) CFSTI: $3.00

Ignition temperatures and ignition delays of ammonium perchlorate in (1) contact with a hot plate and (2) heated glass tubes, studied at temperatures of 250° to 700°C and at pressures ranging from 1 to 300 bar. Both experimental arrangements show that both the ignition delay and the ignition temperature vary considerably with pressure. The activation energy with an unprotected chrome–nickel plate is about 30 kcal $mole^{-1}$. The previous observation that ignition time and ignition temperature are dependent on the size of the sample has been confirmed. The idea that the rate determining step in these experiments is the time taken for the primary product gas to diffuse into the surrounding gas is discussed. Author

N68-12803 Royal Aircraft Establishment, Farnborough (England).
CORRELATION OF VOLTAGE–CURRENT CHARACTERISTICS OF WALL-STABILISED, FREE-BURNING AND CROSS-FLOW ARCS
W. T. Lord Apr. 1967 29 p refs
(RAE-TR-67087)

A comparison is made between non-dimensional forms of the voltage–current characteristics of wall-stabilised, free-burning and cross-flow arcs. Effects of representative length-scale, external heat transfer, the relation between electric conductivity and heat-flux potential, and radiation are displayed. Author

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N68-11983# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
DATA PREPARATION AND BIBLIOGRAPHY FOR THE GYMEA LIBRARY NDXC
J. L. Cook Sep. 1966 12 p refs
(AAEC/TM-343)

A summary of data preparation methods and codes is given together with a compilation of references which were the sources for data contained in the GYMEA cross section library NDXC. Author (NSA)

N68-12001# Library of Congress, Washington, D. C. Aerospace Technology Div.
FOREIGN SCIENCE BULLETIN, VOLUME 3, NUMBER 11 Monthly Review of Selected Foreign Scientific and Technical Literature
Nov. 1967 71 p refs

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1. THE NATURE OF ANOMALOUS PHOTOVOLTAGES IN THE LIGHT OF SOVIET RESEARCH Z. Litynski p 1–27 refs (See N68-12002 03-26)

2. SOVIET STUDIES ON AUTOMATIC CONTROL IN SPACE (1957–1967) B. N. Petrov and B. V. Raushenbakh p 28–40 (See N68-12003 03-10)

3. STUDIES MADE AT THE MOSCOW AVIATION INSTITUTE ON OPTIMIZATION OF CONTROL PROCESSES p 41–44 refs

4. SELF-TRAPPING AND DIFFRACTION OF OPTICAL BEAMS IN A NONLINEAR MEDIUM p 45–46 refs

5. RESISTANCE TO JAMMING IN SECRET COMMUNICATIONS p 47 ref

6. SADKO UNDERWATER LABORATORY p 47–54 refs

7. MARINE SEISMIC INVESTIGATIONS p 54–58 refs

8. CONFERENCE ON TURBULENT HEAT EXCHANGE IN THE ATMOSPHERE p 49–61 ref

9. MECHANICS OF SPACE FLIGHT G. L. Grodzovskiy, Yu. N. Ivanov, and V. V. Tokarev p 62–64

N68-12081*# California Univ., Berkeley. Space Sciences Lab.
ANNUAL CONFERENCE OF EPISCOPAL CATHEDRAL DEANS
Apr. 1967 132 p refs Conf. held in Berkeley, Calif., 7–10 Apr. 1967
(Grant NsG-243)
(NASA-CR-91046) CFSTI: HC $3.00/MF $0.65 CSCL 05K

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1. THE IMPACT OF MODERN SCIENCE AND TECHNOLOGY ON SOCIETY S. Silver p 1–13 (See N68-12082 03-34)

2. CHEMICAL EVOLUTION M. Calvin p 14–24 (See N68-12083 03-13)

3. MOLECULAR BIOLOGY AND GENETICS T. H. Jukes p 25–39 (See N68-12084 03-04)

4. SOCIAL SIGNIFICANCE OF TECHNOLOGICAL ADVANCE I. R. Hoos p 40–64 refs (See N68-12085 03-34)

5. ETHICS OF LARGE SYSTEMS C. W. Churchman p 65–78 (See N68-12086 03-34)

6. THE PRESENT DAY VIEW OF THE PHYSICAL UNIVERSE H. F. Weaver p 79–101 (See N68-12087 03-30)

N68-12082*# California Univ., Berkeley. Space Sciences Lab.
THE IMPACT OF MODERN SCIENCE AND TECHNOLOGY ON SOCIETY
Samuel Silver *In its* Ann. Conf. of Episcopal Cathedral Deans Apr. 1967 p 1–13 (See N68-12081 03-34)

The philosophical content of science and the philosophical content of religion are discussed in the context of the need for an exchange of views among the various segments of society, and the basic desire of man to establish his position in relation to his physical environment and the phenomena of nature. New findings in several fields of science are considered from the point of view of their impact on man's thinking and philosophical base, and several examples are given to illustrate the vast realm of discoveries made in the physical and biological sciences in recent years. The point is made that, purely as knowledge, these findings engage men's minds and raise questions on religion and theology. Technological achievements are cited and related to their impact on the inherent dignity of man. The plea is voiced that man needs a reference frame which sets a level of conscience and of responsibility; therefore, the massive impact of science and technology on society must be interpreted with understanding to provide guidance and perspective. M.G.J.

N68-12085*# California Univ., Berkeley. Space Sciences Lab.
SOCIAL SIGNIFICANCE OF TECHNOLOGICAL ADVANCE
Ida R. Hoos *In its* Ann. Conf. of Episcopal Cathedral Deans Apr. 1967 p 40–64 refs Paper given at Ann. Conf., Berkeley, Calif., 7 Apr. 1967 (See N68-12081 03-34)

The spectacular breakthroughs in science and technology are carefully weighed in terms of their human and social costs and the problems that they generate. The penetration of the computer into practically every facet of life is discussed in terms of the nameless, faceless society which is being created. Consideration is also given to the view that educational technology may be violating basic psychological principles of learning. The impact of mass media on man and his society, the dangers of succumbing to brainwashing manipulation, and the moral erosion that results whenever an individual interacts with a depersonalized system are assessed. The point is made that science and technology must be a part of, instead of apart from, man's moral commitment to the past, present, and future of all mankind. The human element must be considered; purely technical models of society will not suffice. M.G.J.

N68-12086*# California Univ., Berkeley. Space Sciences Lab.
ETHICS OF LARGE SYSTEMS
C. West Churchman *In its* Ann. Conf. of Episcopal Cathedral Deans Apr. 1967 p 65–78 (See N68-12081 03-34)

The use of operations research and management science methods is discussed in terms of the approaches which have been evolved and the way they have been applied. Emphasis is focused on the basic philosophical problems which arise from their use, particularly those involved with satisfying human wants and needs, and the costs entailed in providing the desired services. The view is reiterated that understanding the whole social system is essential in order to approach social improvement by rational methods. The question is raised as to whether there is something about man and his resource environment that does guarantee a gradual improvement. The suggestion is made that a basic course in theology is needed in the business school in order to study the problem of the guarantor of system improvement, and the hope is voiced that applied theology will help to build a saner social system. M.G.J.

N68-12229*# Oklahoma State Univ., Stillwater.
A PILOT PROGRAM FOR SELECTING, EDITING, AND DISSEMINATING ENGINEERING AND SCIENTIFIC EDUCATIONAL SUBJECT MATTER FROM NASA TECHNICAL REPORTS Final Report, Jun. 1, 1966–Aug. 31, 1967
1 Oct. 1967 76 p
(Contract NSR-37-002-045)
(NASA-CR-91044; ER-68-F-2) CFSTI: HC $3.00/MF $0.65 CSCL 05B

The NASA Pilot Program was conducted with an objective of providing up-to-date instructional material derived from current research as rapidly and as efficiently as possible to faculty members engaged in teaching. A total of 17 monographs have been written in three different subject areas of heat transfer, thermodynamics, and control systems. A monograph is described as a technical paper primarily based on one or more NASA research reports and commonly supplemented by other material and is designed to supplement textbook and class note material in a course of instruction. The material is sufficiently complete to be used by the teacher in one to three class periods without undue reference work on his part. Where possible, the monograph contains and develops only one central idea. An instructor's guide orients the instructor on how to use the monograph and the prerequisites and technical significance to be expected. A second facet is the evaluation of visual briefs, which add another dimension to the learning process by providing visual information not readily presented by written material alone. Author

N68-12518# Sandia Corp., Albuquerque, N. Mex.
HIGHLIGHTS OF TECHNICAL PROGRAMS—1966
Dec. 1966 101 p refs Prepared for AEC
CFSTI: HC $3.00/MF $0.65

Information accruing from programs in theoretical and applied sciences is presented. Research efforts concerning: 1) contamination control, 2) dynamic responses of materials and structures, 3) radiation physics, 4) ferroelectrics, 5) aerospace sciences (atmospheric structure and motion, cosmic radiation, and space vehicles and satellites), 6) underground nuclear explosive geophysics, 7) mathematical analyses (numerical analysis, boundary value problems, and network models), 8) physics (crystal growth, electron transfer and penetration, plasmas, and electric properties of crystals), 9) chemistry (ion plating, surface thermodynamics, diffraction, and spectrophotometry), 10) aerothermodynamics, 11) engineering technology, 12) developments of various devices and instruments, and 13) manufacturing technology, are discussed. L.S.

N68-12525*# Missouri Univ., Columbia. Research Center.
THE OWNERSHIP OF INDIVISIBLE INPUTS AND THE AGGLOMERATION OF RESOURCES
Donald Murry 24 Nov. 1967 11 p refs
(Grant NGR-26-004-012)
(NASA-CR-91058) CFSTI: HC $3.00/MF $0.65 CSCL 05C

Authors normally associate the agglomeration of resources at single geographical locations with the presence of indivisibilities; in this analysis we attempt to go beyond that association in order to investigate two factors which appear to affect the tendency of resources to agglomerate spatially. These factors are the ownership of the indivisible input and the utility functions of the entrepreneurs of the firms utilizing the indivisible inputs. Author

N68-12698# European-American Nuclear Data Committee.
THREE YEAR PROGRESS REPORT OF THE ENEA NEUTRON DATA COMPILATION CENTRE, 1964–1967
Douglas W. Colvin May 1967 16 p refs
(EANDC-56(U))

The activities, organization, and services of the ENEA Neutron Data Compilation Center are outlined. NSA

N68-12722# Aerospace Corp., Los Angeles, Calif. System Planning Div.
UNCERTAINTY IN LAUNCH VEHICLE COST ESTIMATING
Jerome G. Fish Oct. 1967 28 p refs
(Contract AF 04(695)-1001)
(TR-1001(2515-01)-1; SAMSO-TR-67-33; AD-661254)

The report presents preliminary results of a study of the uncertainty in estimating future Air Force launch vehicle program costs. This study is part of a larger project to develop a launch vehicle program cost estimating model for the Space Systems Division of the Air Force Systems Command. This model, as well as the uncertainty analysis, is being prepared in support of long range planning and is not directed toward cost estimating problems associated with contract pricing and negotiations. The results of the analysis consist of the first of a two-phase statistical experiment concerning the confidence region associated with the variation of cost estimates derived by using industry cost models. This first phase examines hand-calculated estimates using cost estimating relationships published by industry and others. The second phase, to be reported on later, will deal with industry-computed estimates based on their own computer cost models. Statistical analyses were made of the mean and standard errors of a small sample of hand-computed estimates for total program and subsystem costs for a liquid and a solid fueled launch vehicle. Some tentative inferences are drawn concerning possible causes of the variations of estimates. The sample standard deviations calculated ranged from 7 to 40 percent of the corresponding mean values. Author (TAB)

N68-12754# Sandia Corp., Albuquerque, N. Mex.
CRATERS FORMED BY ROW CHARGES IN THE VERTICAL FACE OF A 90-DEGREE WEDGE
Virgil A. Harris Nov. 1966 35 p refs
(Contract AT(29-1)-789)
(SC-RR-66-477) CFSTI: HC $3.00/MF $0.65

An experiment was conducted to simulate a small-scale overburden stripping by nuclear explosives as the technique might be used to facilitate open-pit mining of oil shale as it occurs near valleys in the Colorado Plateau, and to investigate the changes in crater dimensions and ejecta dispersion with changes in burial depth. Five rows of charges, each containing six 8-pound spheres of cast TNT spaced 4 feet apart, were buried 3.0 feet back from the face of a cliff bank. Charges for each of five shots were buried at depths of 3, 3.5, 4, 4.5 and 5 feet, respectively, and all charges for each shot were detonated simultaneously. Results were restricted by the physical limitations of the terrain used for the experiment. The data imply that too shallow a cut beneath the cliff bank might have restricted the vertical dimensions of the apparent crater. As charge burial depth was increased, horizontal apparent crater radius showed no significant change; vertical apparent crater radius became smaller as did crater depth below the charges; and crater volume decreased. Author (NSA)

N68-12778# Sandia Corp., Albuquerque, N. Mex.
A SMALL-SCALE INVESTIGATION OF EXCAVATION WITH PARALLEL ROWS OF EXPLOSIONS, PART 2
L. J. Vortman Oct. 1966 50 p refs
(Contract AT(29-1)-789)
(SC-RR-66-416) CFSTI: HC $3.00/MF $0.65

An earlier experiment, in which craters were made by simultaneously detonating parallel rows of charges, was continued using smaller spacing between charges in the rows and between the rows themselves, together with greater burial depth, in an effort to achieve a more effective use of explosive in terms of apparent crater volume per unit of energy than had been observed for three similar rows detonated separately. Although an increase in volume per unit of energy over the simultaneously detonated rows of charges was observed, the cratering effectiveness of three rows separately detonated was not achieved. Permanent vertical and horizontal displacement of the surface near the crater edge could not be correlated with any of the more obvious variables. Patterns of ejecta from the explosion seemed unrelated to charge spacing or burial depth, but displayed an azimuthal relationship about the multiple rows similar to that observed for single rows. When two rows of charges were detonated simultaneously, there was no notable difference between craters formed when the charges in one row were directly opposite those in the other row, and where the charges in one row were offset one-half space from those in the other. Author (NSA)

N68-12782# Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering.
WORD ASSOCIATION EXPERIMENTS—BASIC CONSIDERATIONS
Don Stone 5 Aug. 1966 19 p refs
(Contract AF 49(638)-1421)
(AD-660085)

The report analyzes two approaches to information retrieval: automatic classification and statistical association techniques, including what Doyle calls associative machine searching. TAB

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Oklahoma: Oklahoma City
Tennessee: Memphis
Texas: Fort Worth and Dallas
Washington: Seattle
Wisconsin: Milwaukee

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—NATIONAL AERONAUTICS AND SPACE ACT OF 1958

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